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THE ORIGIN OF THE VERTEBRATE SKELETON.

BY J. S. KINGSLEY.

Until a very recent date, not a doubt existed that any part of the vertebrate skeleton was of other than mesodermal origin. The cartilages were mesoderm, and in their further development the cartilages were transformed into bone by means of the cells from the same parent layer. The membrane bones of the skull were also believed to mesodermal, since the researches of Oscar Hertwig ('74) had shown that in the Batrachia especially, as well as in other forms, they arose from the layer which formed the dentine of the teeth, and which was homologous with that which formed the dentine of the placoid scale. The details of this need not be given here, as they will will be found in every text-book; the point to be emphasized is that dentine and its homologue membrane bone were assumed to be, and even thought to be proved to be, of mesodermal origin.

One of the first papers to lay a foundation for a different view was one by Kastschenko ('88), which, while saying nothing of the origin of the skeleton, pointed out that certain parts of the mesenchyme were of ectodermal origin. Next, another Russian, Goronowitsch ('92), showed that in the formation of the "ganglionic folds" into the head, not all the tissues proliferated from the ectoderm into the "ganglienleisten" was used up in

the formation of nervous matter, but that some of it became mesenchymatous and was possibly utilized in the development of the skeleton. Other authors at about the same time confirmed more or less clearly this view that all mesenchyme was not of entodermal, but that at least some of it was ectodermal, in origin.

In 1893, Miss Julia B. Platt, in a preliminary paper, made the noteworthy statement that the embryology of Necturus showed that, at least in the head, the cartilages were derived from the ectoderm. Necturus was especially favorable in this respect, for its cells are larger and pigment is absent. At about the stage of the formation of the ganglienleisten, the differences between the entoderm and mesothelial tissues on the one hand, and the ectoderm on the other, were very great, the former being loaded with yolk granules, the latter containing comparatively few. Further, the layers readily differentiated by staining with the Erlich-Biondi mixture. With the formation of the ganglienleisten from the ectoderm, its cells could be distinguished in the same way, and it was found that only the dorsal portion of ridge becomes nervous, the lower contributing its cells to the mesenchyme, while between the two regions there was a portion which contributed to both tissues. These ectodermal mesenchymal parts (mesectoderm, as Miss Platt calls them) can readily be distinguished after their separation from the parent layer by the peculiarities already mentioned. From these proliferations tissue arises which later forms the gill cartilages, while further in front, near the eyes and the nose, similar ingrowths are seen, and especially in the region where the mouth is to break through. From these last arise at least the trabecular cartilages; the origin of the parachordals and otic capsule is not given.

In a second paper ('93[a]), Miss Platt further elaborates some of her earlier statements, illustrating the parts with three figures, one of which shows the downward growth of the mesectoderm, to use her extremely convenient term, between the gill clefts and in the region of eye and nose.

Before the appearance of Miss Platt's second paper, Goronowitsch published his detailed account ('93), fully confirming

the statements of his preliminary, and showing that ectodermal ingrowths occur in the birds in just such positions as to justify the view that they gave rise to skeletal structures. Some of these, according to Goronowitsch, found their destiny in the cutis, a fact to be remembered while considering the work of Klaatsch, outlined below. A little later (93[a]) Goronowitsch published a short note in which, among other points, he claimed that Miss Platt had not made good her thesis that these mesectoderm cells gave rise to the cartilage. Miss Platt's final paper will, we understand, soon appear.

The most important and most detailed paper of all is that of Klaatsch, which appeared in April of this year. Its title—" On the Origin of the Scleroblasts. A Contribution to the Knowledge of Osteogenesis "—shows its scope. We can give but the merest outline of the points detailed in the 90 pages of the paper.

The first point considered is the development of the placoid scale. This, as is well-known, consists of two portions, a harder outer portion, the enamel secreted by the basal ends of cells of undoubted ectodermal origin; and a deeper dentine which, up to now, has been universally regarded as of true mesodermal nature. Klaatch studied the development of the placoid organ in several species of Acanthias, Mustelus and Heptanchus. These presented various differences, but in general, they agreed in the following features. In the earlier stages the ectoderm is two cells in thickness, a flattened superficial layer and a deeper cubical or columnar layer. Between this last and the corium is a clear space, and there is no continuous basal membrane. A little later this deeper layer begins to undergo modifications, cells being budded from it into the clear space. These cells are readily seen to belong to the ectoderm, not only from the directions of the mitotic spindles, but from the fact that their nuclei are greatly larger than those of the corium, the only other layers from which they could arise. These cells are the scleroblasts. They are not scattered irregularly through the clear space, but are more abundant in some places than in others, thus early marking out the positions of the later placoid organs. With the modi-

fications of the ectoderm described by Klaatsch, we have nothing to do here further than is concerned in the scale development. It is to be noticed that along with the formation of the little patches of scleroblasts the overlying cells of the basal layer become elongated, the first step in the development of an enamel organ. The later stages in their general features are much as described by Oscar Hertwig in his classic paper of twenty years ago, and yet there are important differences to be noted. The heaping up of the scleroblasts continues, the result being the formation of the dentine organs, carrying with it the superposed enamel cells in the form of a pyramid. The enamel organ is terminated on all sides by a groove, and even at this stage the cells at the bottom of this groove are actively engaged in proliferating additional scleroblasts which are pushed into the still-growing dentine organ. The necessary conclusion is not only is the enamel of the placoid scale an ectodermal derivation, but such is the nature of the dentine as well.

Now placoid scales and teeth have long been regarded as homologous structures, and so Klaatsch studies the history of the latter. In the sharks he finds that the conditions of the development of the scales are paralleled in the ontogeny of the teeth. There is the same early proliferation of scleroblasts into the clear layer, and later, when the enamel cap is formed, its limiting groove is the seat of additional ingrowth of dentine-forming cells. In short, we must no longer regard the teeth as structures derived from two germ layers—ectoderm and mesoderm—but as purely ectodermal products.[1]

In the fin of the shark are numerous horny rays, and their history is followed. Earlier workers had universally regarded them as belonging to the connective-tissue series, although in 1885 Krukenberg had shown that their organic base was different from the chemical standpoint from the other connective tissues. Klaatsch finds that here there is a similar inwander-

[1] It is to be noted that in the recent meeting of the Anatomische Gesellschaft at Strassburg, May 13–16, Professor Rabl had a paper "Ueber die Herkunft des Dentinkeims in den Placoidschuppen und den Zähnen der Selachier (gegen Klaatsch)." The publication of this will be waited with interest.

ing of ectoderm cells into the region between the basal epithelium and the corium. From these cells are produced at first extremely minute horny rods, and these, later, together with their parent cells, sink through the corium into the position they finally occupy, where no one, not tracing their history in detail, would suspect their ectodermal origin. Even in Torpedo, where no horny rays occur in the paired fins of the adult ingrowths of ectoderm into the axial portions of the fin exist. At this point one author supports Rabl in his view that the unpaired fins are not derived from the fusion of paired rudiments. The opposite view is fastened upon Dohrn, regardless of the fact that it was first shown to be probable by J. K. Thacher and later supported by Balfour. Dohrn's special contention was that the fins, paired and unpaired, were derivatives of the parapodia of the worms, and later, Paul Mayer claimed to have found structures—"parapodoids"—which represented these. These "parapodoids" are, according to Klaatsch's view, the early placoid organs.

In studying the development of true bone, Klaatsch studied *Salmo salar*. Here the earliest to appear were the opercular bones, and but little later those of the shoulder girdle and those arising in connection with the teeth, later those of the cranium. The details of the formation of the scleroblasts for a few of these bones is given, including the squamosal, operculum, clavicula, dentary, and the osseous fin-rays. In the case of each, the osteoblasts are derivatives of the ectoderm. The squamosal is especially interesting, since it begins from outgrowths at the point of the infolding of the mucous canals, and is developed in connection with these organs. At first it is connected solely with them, and is plainly a membrane bone; later it comes into contact with the otic capsule. Klaatsch sides with those who would make no sharp distinction between cartilage- and membrane-bones, and regards not only the squamosal but the cranial roof and the ossifications which appear in the cranial roof and on the primordial cranium as having their origin in bones developed, like the squamosal, for protection of the cutaneous sense-organs.

After discussing these, Klaatsch passes to the bony fin-rays of the Teleosts and then to their scales, giving details which our space will not allow us to repeat, but in each case he comes back to the conclusion that in each and every case the so-called mesodermal element is of ectodermal origin. Then a few instances are taken from other groups—Salamandra and Lepus. In the Batrachia he finds the same conditions as in sharks and Teleosts. In the Mammals he fails to trace the history of his scleroblasts, but he finds here, as elsewhere, proliferations of ectodermal cells into the subadjacent tissues, which, it is possible, may later form the skeletogenous cells.

It needs hardly be said that these various contributions thus superficially summarized are most important, since, if they be confirmed, they will tend to an overthrow of many ideas long believed to be firmly grounded. The questions concerned are far from settled, but we venture to predict that the subject will occupy a prominent place in the morphological literature of the immediate future.

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VARIATION OF NORTH AMERICAN FISHES.*

I.

THE VARIATION OF ETHEOSTOMA CAPRODES RAFINESQUE.

By W. J. Moenkhaus.

Etheostoma is a genus of American Freshwater Percidæ. It consists of about 100 species distributed in a number of subgenera. All the members of the genus are small. They are distributed over approximately the entire Atlantic slope of North America. The northernmost points are Fort Quappelle and Montreal; the southernmost, Chihuahua. The most west ern points are Colorado and Swift Current in Canada near the 108th meridian.

The subgenus Percina includes the largest of the darters. There are but two well-defined species. One, *Etheostoma rex* is known from east of the Alleghany Mountains. The other, *Etheostoma caprodes* is also found east of the Alleghanies, but its chief habitat is west of these mountains, where it is found from Lakes Champlain and Superior to the Rio Grande.

This latter species, *Etheostoma caprodes* Rafinesque, has been studied with a view to ascertain the extent of its variation, the relation of its variation to its geographical distribution, the extent of variation in each locality, and the variation with age. This species of the darters has been selected for its size, and on account of its wide distribution and moderate abundance within its limits. Its variability has been known for a long time, and has given it a number of specific names.

The material examined is recorded in the table of measurements and counts.

The greatest variation was found to be in the color. Slighter variations were found in proportions and number of fin rays.

* Contributions from the Zoological Laboratory of Indiana University, under the direction of Carl H. Eigenmann, No. 10.

Evolution of the Color Pattern.

As just stated, the point of greatest variability is the color pattern. The colors in life are not taken into consideration, but only the black markings which were preserved in alcoholic specimens. On comparing living specimens with alcoholic material, but little difference was noticed. In the matter of color patterns, the specimens from any one locality agree to a remarkable extent. This statement refers only to specimens of the same size—differences, of course, existing between young and adult stages.

The simplest pattern was found in specimens from Chocola Cr., Ala. These were immature specimens, and do not represent the adult condition.

In these specimens (30 and 33 mm. long., fig. 1), we have a series of nine cross-bars extending from the back to below the middle of the sides. The bars at the ends of the dorsal fins are much emphasized, and all the bars are heaviest at their upper and lower ends. There is a distinct round spot at the root of the caudal. The color of the head need not be taken into consideration in this specimen. The caudal spot remains in all the specimens examined. The most complicated pattern, that of fig. 7, is shown to be derived by easy stages and step by step from the condition figured in fig. 1.

The simplest pattern in adult fishes is found in specimens inhabiting the waters of the Wabash River and its tributaries in Indiana (Nos. 9, 40 and 44). The pattern here consists of a series of long and short bars alternating. In the anterior region, the short bars are usually as long as the long bars. A better way to designate these is to term the long bars "whole bars," and the short bars "half bars." The whole bars towards the posterior end of the body spread slightly and become more intensely colored toward their ventral extremity. The black caudal spot is also present here. This spot does not vary in any of the patterns figured. The head is colored black above, and has a large spot on the opercle, taking the general form of the opercle itself. The color on the top of the head is most intense towards the posterior, as shown in fig. 9, and becomes less less distinct as it extends forward to the tip of the snout.

Around the eyes are seen faint indications of three bars: one extending forward; the second downward, and the third backward (fig. 2).

Comparing this pattern with the one in the young, we find that the whole bars are homologous in the two, and that the half bars have been added.

A step in advance is taken by the adult specimens from Chocola Cr., Ala., fig. 3 (Nos. 76–82). These have the bars alternately long and short along the entire length of the body. The bars are considerably broader and more intense, and the whole bars have their ventral extremities much broadened, so as to form quite an apparent series of spots along the side. An additional half bar is added by the union of the spot above and the spot just in front of the black caudal spot. Here the three bars radiating from the eye are somewhat more distinct than in the pattern already described.

The next series of individuals are Nos. 45–55, 72, 73 and 75, in the list given below, and are represented by fig. 4. They are found in the Green, Cumberland, Tennessee and Arkansas River Basins. The color pattern here shows a greater irregularity in its bars, and has developed in addition a still shorter between each of the whole and half bars of the preceding pattern, so that we have now whole, half and quarter bars. The series of lateral spots is present only along a part of the body. The bar extending anteriorly from the eye is broken into two shorter and less distinct ones.

Of considerable significance in the specimen figured in fig. 3 is the fact that in the bar between the dorsals, we have a notch indicating that some of the color-cells are separating from the whole bar. A similar condition is shown in the same region of fig. 4. The quarter bars are apparently split off from the other bars. It is of interest that variations in the direction of an increased number of bars is always, as far as my specimens go, introduced at this point. Specimens intermediate between this and the preceding form show that the quarter bars always make their first appearance between the seventh and eighth whole bars and the included half bar.

Other quarter bars are then added in front and behind this region.

From the conditions represented in fig. 3, we have two diverging lines of development. The one line was discussed in the preceding paragraph. The other line is found in specimens, Nos. 82 and 83, taken from San Marcos Spring, Texas, and is represented in fig. 5. We have here a splitting of the bars without the regular result seen in fig. 4. The lower ends of the whole bars have not split, in fact, they have increased in width, and form a very prominent series of spots along the side. It will be seen that the bars radiating from the eye have become much more pronounced.

The pattern of fig. 6 can be easily derived from the preceding one by assuming that the lower half of the whole bars of the anterior part of the body have shifted their position backward, so that they no longer extend extirely to the mid-dorsal line. The 3d, 4th and 5th whole bars show different degrees of shifting. The lower part of the 4th has shifted, but still retains its connection with the upper part. In the 3d, the bar is more nearly separated, while in the 5th the separation is complete, and the original lower part of the bar becomes simply a vertically elongated spot. The bars around the eye are here again less developed. The pattern of fig. 6 is the one occurring in *Etheostoma caprodes manitou* Jordan, and was drawn from a specimen taken from Torch Lake, Mich. Other specimens, taken from the same lake and from other localities, have the same color pattern with slight variations. Nos. 1–7, and 41 of Table I, are this variety.

The line of development taken up by fig. 5 is continued in figs. 7 and 8, representing the specimens from Obey's River and Eagle Creek in Tennessee, and from the Little South Fork of the Cumberland River in Kentucky. These are Nos. 56–72 in the table. A single young specimen, No. 74, which promised to become this form, was also taken in the North Fork of the Holston River, in Virginia. The two figures were drawn from a younger and older specimen respectively, of the same form. In the younger specimens, the bars have become more split up, and have increased in irregularity. Almost all of

the original bars, however, can be traced. The lateral spots, too, are much more prominent than in the preceding pattern. In the older individuals the bars have become so much split up as to form a complicated network, and the original pattern can be made out only in a general way. The spots are larger and darker than in the younger, and form almost a continuous lateral band. The radiating bars around the eyes are correspondingly more developed, the one extending backward in a slight curve beyond the head to the first lateral spot.

In the last pattern, the original simple whole and half bars have reached their greatest modification, and the faint lateral spots of fig. 2 have become the most prominent part of the coloration.

The variation presents a serial modification in two divergent lines from an original simplest pattern. Beginning with the whole bars of fig. 1, we pass to the form having alternate whole and half bars, and an imperfect series of lateral spots. From this form we pass on the one hand to the pattern having alternate whole, half and quarter bars, and on the other hand to the pattern consisting of reticulated markings above, and a very prominent series of spots along the sides. In the pattern of fig. 6, we have a second divergent line of development from fig. 5. The radiating bars around the eyes become more developed as we pass from the simple to the more complex patterns, with the exception in fig. 6.

It will be seen from the localities at which each of the various patterns occurred, that there is no definite serial relation between the variations and the latitude at which they are found. As already stated, however, the variations are remarkably definite for a given locality. The specimens from the Wabash waters can, almost without exception, be distinguished from those of the Cumberland River, for instance, while those from the Alabama River are distinguished by their invariably broader bars. Both the patterns of figs. 4 and 6 occur in the Cumberland and Tennessee River system, but both have not been taken from the same tributaries of these streams.

The color-pattern of *Etheostoma caprodes* is of interest when considered as to its bilateral symmetry. In most of the sim-

plest patterns, the corresponding bars on the two sides are exactly alike, and precisely meet each other in the mid-dorsal tine. This almost perfect symmetry is not so prevalent in the more complex patterns. The simplest cases of asymmetry are found in the simplest patterns when some of the bars do not exactly meet their fellows on the back. Fig. 8 shows an instance of this kind. Both the asymmetrical and the symmetrical forms occur in the same locality, and the former seems purely accidental, but in all cases observed, it makes its first appearance in the bars along the spinous dorsal. From this point it spreads backward along the soft dorsal until we reach an extreme form of asymmetry, as represented in fig. 9. Here the first three and the last four bars, together with the bar between the dorsals, still preserve their symmetry, while those along the entire length of both dorsals are quite asymmetrical.

In regard to variations in parts other than in the color pattern, only those points of structure were examined that could be most accurately made out on alcoholic specimens. One very marked departure from the regular form exists in the specimens from San Marcos Spr., Texas. This departure consists, as shown in fig. 5, of an increase in the depth of the body in the region of the spinous dorsal, as a result of the unusual elevation of the back in this region. These belong to the variety carbonaria, described from Texa, and are more distinct in points of form than the varieties I examined from any other locality.

No. 8 in Table I, taken by Dr. Meek at Cedar Rapids, Iowa, differs materially from any of the specimens from other localities. It approaches nearest the variety zebra in the color pattern, and in having no scales before the spinous dorsal. The scales, however, are larger, there being but 76 in the lateral line. The head measures 3½ in body and the number of rays in anal is 12.

The following table will give the number of specimens, their locality and the points of structure which have been examined. The spines in the dorsal and anal fins are indicated by Roman numbers and the rays by Arabic numbers. The length of the

specimens are measured in mm. from the tip of the snout to root of caudal. Only those scales of the lateral line are counted which have the tribes developed in them. The localities are arranged in the order of their latitude from north to south.

TABLE I.

Locality.	Figures representing these types.	Length of body in mm.	Length of head in mm.	Head in body.	Dorsal fin.	Anal fin.	Scales in lateral line.
1. Torch Lake, Mich.	6	77	19	$4\frac{1}{19}$	XIV,15	II,10	90
2. " " "	6	76	19	4	XIV,15	II,10	90
3. " " "	6	80	20	4	XV,15	II,10	85
4. " " "	6	75	$18\frac{1}{2}$	$4\frac{1}{18}$	XV,15	II,10	89
5. " " "	6	80	20	4	XV,15	II,10	90
6. " " "	6	77	19	$4\frac{1}{19}$	XIV,14	II,10	90
7. " " "	6	73	18	$4\frac{1}{18}$	XV,16	II,11	90
8. Cedar Rapids, Iowa	6	70	20	$3\frac{1}{2}$	XIV,15	II,12	76
9. White River, Indianapolis, Ind.	2				XIV,16	II,10	86
10. Racoon Creek, Mecca, Ind.	2	40	$10\frac{3}{4}$	$3\frac{9}{10}$			89
11. " " " "	2	42	11	$3\frac{9}{11}$			90
12. " " " "	2	41	11	$3\frac{8}{11}$			90
13. Gosport, Ind.	2	90	21	$4\frac{2}{7}$	XV,15	II,10	90
14. " "	2	50	13	$3\frac{11}{13}$	XIV,15	II,10	88
15. " "	2	38	10	$3\frac{4}{5}$	XV,15	II,10	90
16. " "	2	47	13	$3\frac{8}{13}$	XV,15	II,10	87
17. " "	2	53	14	$3\frac{11}{15}$	XV,15	II,10	90
18. Bean Blossom, Ind.	2	67	17	$3\frac{16}{17}$	XV,16	II,10	87
19. " " "	2	84	22	$3\frac{4}{11}$	XIV,16	II,11	90
20. " " "	2	94	24	$3\frac{11}{12}$	XIV,17	II,11	88
21. " " "	2	$86\frac{1}{2}$	$22\frac{1}{2}$	$3\frac{9}{22}$	XV,16	II,11	85
22. " " "	2	83	21	$3\frac{20}{21}$	XIV,16	II,11	86
23. " " "	2	113	27	$4\frac{5}{27}$	XV,15	II,11	86
24. " " "	2	$71\frac{1}{2}$	$18\frac{1}{2}$	$3\frac{17}{18}$	XIV,16	II,10	88
25. " " "	2	82	$21\frac{1}{2}$	$3\frac{16}{21}$	XIV,16	II,10	87
26. " " "	2	77	21	$3\frac{2}{3}$	XV,16	II,11	88
27. " " "	2	71	18	$3\frac{8}{9}$	XIV,16	II,11	88
28. " " "	2	61	16	$3\frac{3}{4}$	XV,16	II,10	87
29. " " "	2	44	11	4	XIV,16	II,11	85
30. " " "	2	42	11	$3\frac{9}{11}$	XV,16	II,10	86
31. " " "	2	47	13	$3\frac{8}{13}$	XIII,16	II,10	85
32. " " "	2	96	24	4	XV,15	II,11	88
33. " " "	2	73	18	$4\frac{1}{18}$	XIV,16	II,10	85
34. " " "	2	68	17	4	XIV,16	II,10	86
35. " " "	2	35	10	$3\frac{1}{2}$			
36. " " "	2	33	9	$3\frac{2}{3}$			
37. Rushville, Ind.	2	88	22	4	XIV,15	II,10	90
38. Wild Cat Creek, Kokomo, Ind.	2	130	32	$4\frac{1}{16}$	XV,16	II,11	85

Locality.	Figures representing these types.	Length of body in mm.	Length of head in mm.	Head in body.	Dorsal fin.	Anal fin.	Scales in lateral line.
39. Pike Creek, Ind.	2	107	26	$4\frac{3}{26}$	XIV,16	II,11	89
40. " " "	2	102	25	$4\frac{2}{25}$	XV,16	II,11	91
41. Illinois	2	65	15	$4\frac{1}{3}$	XV,14	II,10	89
42. Nipisink Lake, Ills.	2				XV,15	II,10	85
43. " " "	2				XIV,15	II,11	85
44. Monongahela River, Pa.	4	96	23	$4\frac{2}{23}$	XV,15	II,10	85
45. Hartford, Ky.	4	76	19	4	XVI,14	II,10	88
46. " "	4	76	19	4	XV,15	II,10	87
47. " "	4	76	19	4	XIV,16	II,10	88
48. " "	4	78	19½	4	XV,16	II,11	90
49. Green River, Greensburg, Ky.	4	85	20	$4\frac{3}{20}$	XV,15	II,10	89
50. " " " "	4	90	21½	$4\frac{4}{21}$	XV,16	II,11	92
51. " " " "	4	77	17½	$4\frac{7}{19}$	XV,15	II,11	85
52. Little Barren River, Osceola, Ky.	4	92	23	4	XV,15	II,11	89
53. " " " " "	4	69	17	$4\frac{1}{17}$	XV,14	II,11	89
54. " " " " "	4	69	17	$4\frac{1}{17}$	XVI,15	II,11	89
55. " " " " "	4	69	17	$4\frac{1}{17}$	XIV,16	II,11	83
56. Little S. Fork Cumberland River, Wayne Co., Ky.	7 & 8	103	25	$4\frac{1}{8}$	XVI,15	II,11	92
57. Eagle Creek, Olympus, Tenn.	7 & 8	82	21	$3\frac{19}{21}$	XVII,14	II,11	87
58. " " " "	7 & 8	61½	16	$3\frac{13}{16}$	XVI,15	II,11	92
59. Obey's River, " "	7 & 8	77	18	$4\frac{5}{18}$	XVII,14	II,11	89
60. " " " "	7 & 8	86	21	$4\frac{2}{21}$	XV,14	II,10	86
61. " " " "	7 & 8	55	13½	$4\frac{1}{13}$	XVI,15	II,12	89
62. " " " "	7 & 8	66	17	$3\frac{15}{17}$	XVI,15	II,12	90
63. " " " "	7 & 8	62	15	$4\frac{2}{15}$	XVII,15	II,12	87
64. " " " "	7 & 8				XVII,15	II,11	90
65. " " " "	7 & 8	65	16½	$3\frac{15}{16}$	XV,17	II,11	90
66. " " " "	7 & 8	53	14	$3\frac{11}{14}$	XVI,15	II,11	89
67. " " " "	7 & 8	54	13½	4	XVII,15	II,12	86
68. " " " "	7 & 8	60	15	4	XVII,15	II,12	91
69. " " " "	7 & 8	51½	12½	$4\frac{1}{12}$	XVII,14	II,12	85
70. " " " "	7 & 8	53½	13	$4\frac{1}{13}$	XVII,15	II,12	89
71. " " " "	7 & 8	57½	14½	4	XVII,15	II,11	90
72. Watauga River, Elizabethtown, Tenn.	4	122	27		XVI,16	II,11	92
73. " " "	4	94	21		XV,16	II,10	92
74. North Fork Holston River, Saltville, Va.	7 & 8	47½	13	$3\frac{9}{13}$	XVI,15	II,12	92
75. Eureka Springs, Ark.	4	112	24	$4\frac{2}{3}$	XVI,15		
76. Chocola Creek, Oxford, Ala.	3	94	21	$4\frac{10}{21}$	XVI,15	II,11	91
77. " " " "	3	97	18	$4\frac{5}{18}$	XV,17	II,12	78
78. " " " "	3	89	21	$4\frac{5}{21}$	XVI,17	II,11	93
79. " " " "	3	78	17	$4\frac{10}{17}$	XV,15	II,11	90
80. San Marcos Spring, Texas	5	95	21	$4\frac{11}{21}$	XIII,15	II,11	85
81. " " " "	5	102	24	$4\frac{1}{3}$	XIV,15	II,11	93
82. " " " "	3	27	7	$3\frac{6}{7}$			
83. " " " "	3	30	8	$3\frac{3}{4}$			

Table II presents all the combinations of dorsal spines and dorsal rays, and the number of specimens having the given combination. (But 76 of the specimens have been examined for this table.) The combinations are arranged in the numerical order of the spines from the lowest number to the highest. In the third column are given the per cents. of specimens having each combination. XV, 15 is seen to be the commonest combination; XIV, 16 the next, XV, 16 and XVI, 15 the next, and so on. The largest per cent. of any combination does not exceed 21.052.

TABLE II.

Dorsal Fins.	Number of specimens.	er cent. of specimens.
XIII, 15	1	1.315
XIII, 16	1	1.315
XIV, 14	2	2.631
XIV, 15	6	7.895
XIV, 16	12	15.789
XIV, 17	1	1.315
XV, 14	3	3.947
XV, 15	16	21.05
XV, 16	11	14.47
XV, 17	2	2.631
XVI, 14	1	1.315
XVI, 15	9	11.841
XVI, 16	1	1.315
XVI, 17	1	1.315
XVII, 14	3	3.947
XVII, 15	6	7.894

In Table III are arranged the varieties in the number of dorsal spines, the number of specimens representing each variation, and the per cent, of all the specimens for each variation. The average number of spines is $15\frac{5}{76}$, while the number of spines predominating is 15.

TABLE III.

Dorsal Spines.	Number of specimens.	Per cent. of specimens.
XIII	2	2.631
XIV	21	27.63
XV	32	42.11
XVI	12	15.789
XVII	9	11.841
Average number of spines		$15\frac{5}{76}$

In Table IV the same data are given for the dorsal rays. The average number of rays is $15\frac{6}{19}$, about the same as the spines. Fifteen is seen to be the number in about 50 per cent. of all the specimens examined. While 42.11 per cent. have fifteen dorsal spines, and 50.007 per cent. have fifteen dorsal rays, only 21.05 per cent. have a combination of fifteen spines and fifteen rays.

TABLE IV.

Dorsal Rays.	Nnmber of specimens.	Per cent. of specimens.
14	9	11.841
15	38	50.007
16	25	32.90
17	4	5.262
Average number of rays		$15\frac{6}{19}$

The variations in the anal fin are given in Table V. The anal fins of only 76 specimens were examined.

PLATE XVIII.

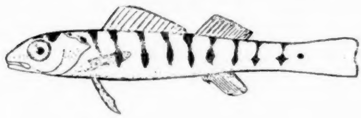


Fig. 1.

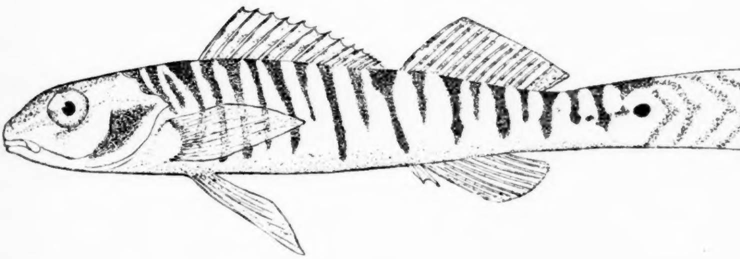


Fig. 2.

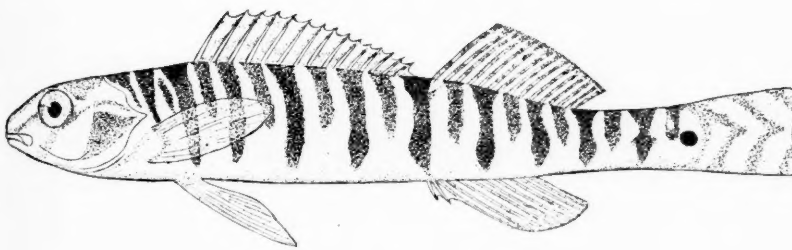


Fig. 3.

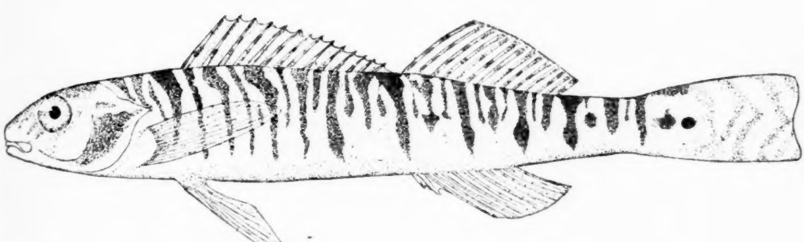


Fig. 4.

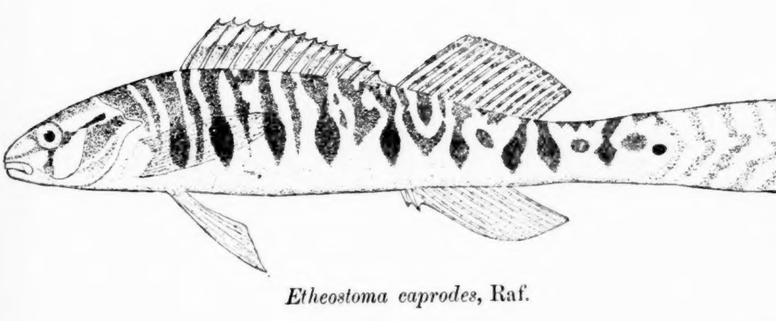


Fig. 5.

Etheostoma caprodes, Raf.

PLATE XIX.

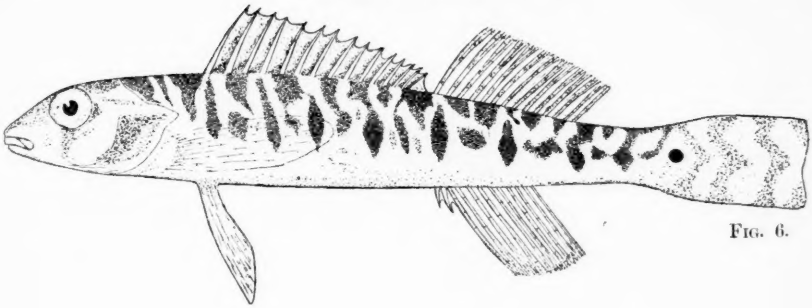


Fig. 6.

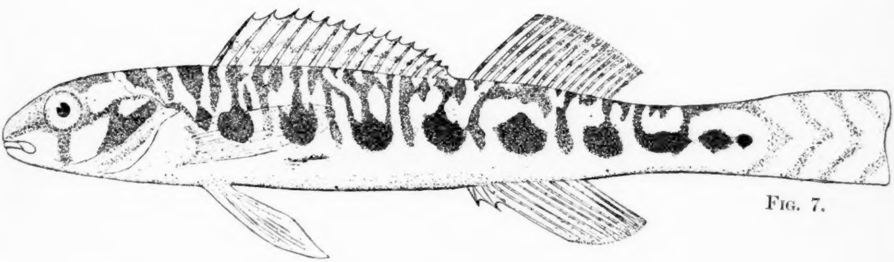


Fig. 7.

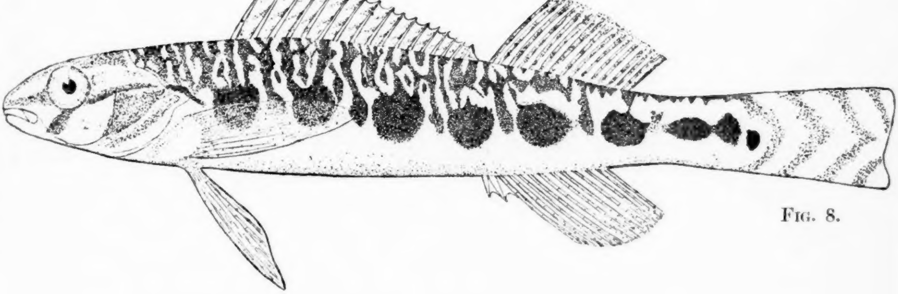


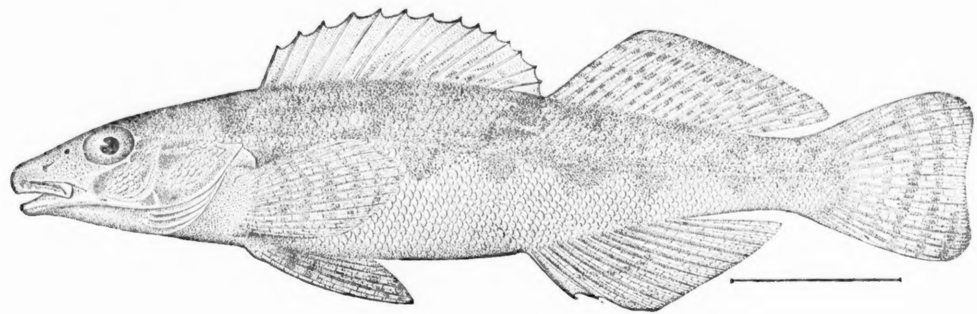
Fig. 8.

Fig. 9.

Fig. 10.

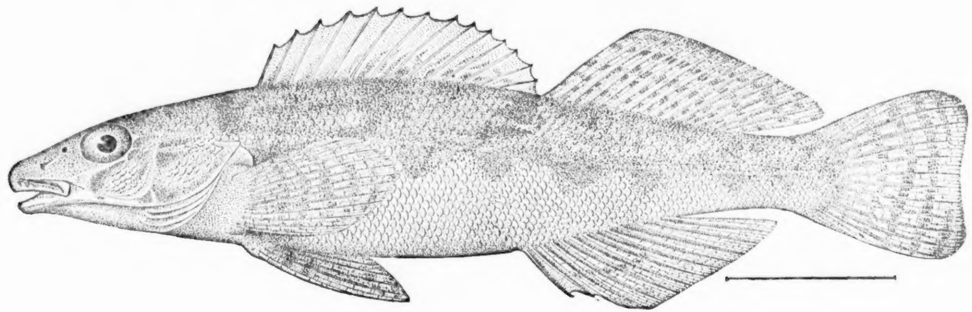
Etheostoma caprodes, Raf.

PLATE XX.



Etheostoma rex, Jordan.

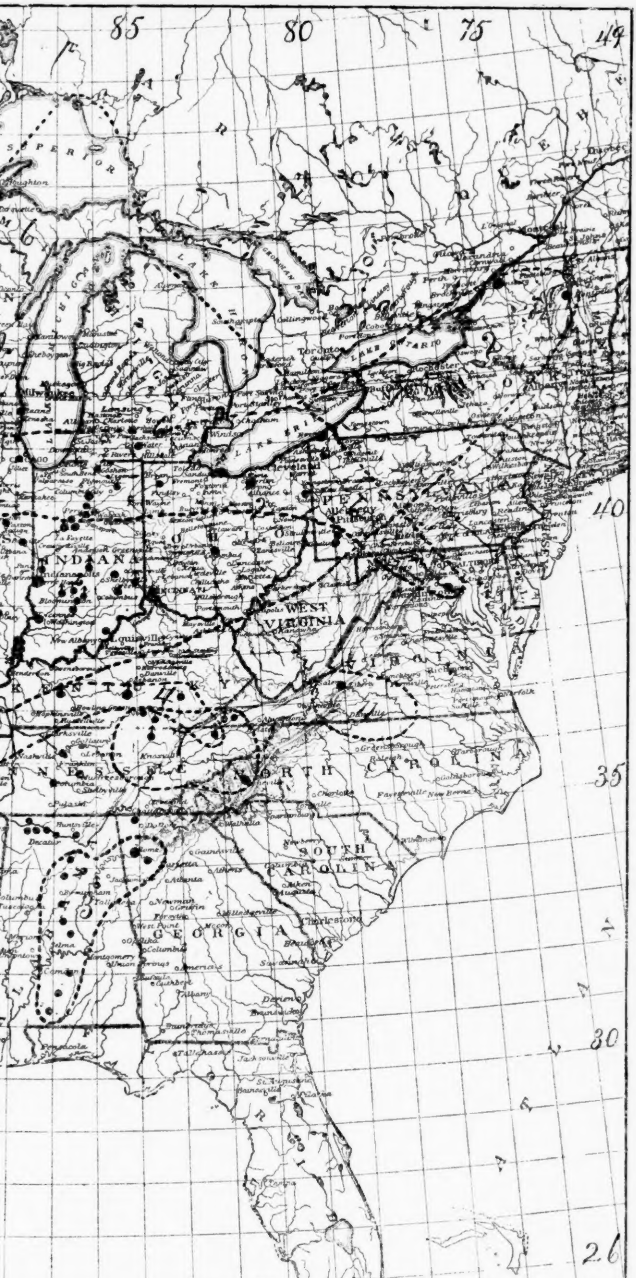
PLATE XX.



Etheostoma rex, Jordan.

Distribution of Etheostoma

E XXI.



Etheostoma caprodes.

TABLE V.

Anal Fins.	Number of specimens.	Per cent. of specimens.
II, 10	30	39.47
II, 11	36	47.37
II, 12	10	13.15
Average number of anal rays		$10\frac{14}{19}$

In Table VI are given the variations in the number of scales in the lateral line. The scales were counted on 79 specimens. Eighty-five was the number found in a number having the lateral line incompletely developed. Eighty-five, eighty-eight, eighty-nine and ninety were found in about 60 per cent. of the specimens examined.

TABLE VI.

Scales with Pores.	Per cent. of specimens.	Number of specimens.
76	1	1.265
78	1	1.265
83	1	1.265
85	12	15.20
86	7	8.86
87	7	8.86
88	8	10.12
89	12	15.20
90	18	22.77
91	3	3.80
92	7	8.86
93	2	2.53
Average number of scales		$88\frac{11}{79}$

Table VII indicates the number of specimens, the average number of dorsal spines, and the number of specimens with thirteen, fourteen, fifteen, sixteen and seventeen spines from each of the localities from which specimens were examined. The localities are arranged as they occur, from north to south. It will be seen that the prevailing numbers occurring in the more northern streams are fourteen and fifteen. As we go farther south the usual number is fifteen and sixteen, and in the most southern streams the numbers are fifteen, sixteen and seventeen spines, the specimens from Texas are peculiarly poor in the number of spines.

TABLE VII.

LOCALITY.	Number of specimens.	Average number of dorsal spines.	Number of specimens with 13.	Number of specimens with 14.	Number of specimens with 15.	Number of specimens with 16.	Number of specimens with 17.
Torch Lake, Mich	7	$14\frac{4}{7}$		3	4		
Cedar Rapids, Ia	1	14		1			
White River, at Indianapolis	1	14		1			
Gosport, Ind	5	$14\frac{4}{5}$		1	4		
Bean Blossom, Ind	17	$14\frac{6}{17}$	1	9	7		
Rushville, Ind	1	14		1			
Wild Cat Creek, Ind	1	15			1		
Pike Creek, Ind	2	$14\frac{1}{2}$		1	1		
Illinois	1	15			1		
Nipisink Lake, Ill	2	$14\frac{1}{2}$		1	1		
Monongahela River	1	15			1		
Hartford, Ky	4	15		1	2	1	
Green River, Greensburg, Ky	3	15			3		
Little Barren River, Osceola, Ky	4	15		1	2	1	
Little South Fork Cumberland River, Wayne Co., Ky	1	16				1	
Eagle Creek, Olympus, Tenn	2	$16\frac{1}{2}$				1	1
Obeys River, Elizabethtown, Tenn	13	$16\frac{6}{13}$			2	3	8
Watauga River, " "	2	$15\frac{1}{2}$			1	1	
North Fork Holsten River, Saltville, Va.	1	16				1	
Eureka Springs, Ark	1	16				1	
Chocola Creek, Oxford, Ala	4	$15\frac{1}{2}$			2	2	
San Marcos Springs, Tex	2	$13\frac{1}{2}$	1	1			

Table VIII contains the same data with regard to the dorsal rays. In the last column is given the average number of dorsal spines and rays combined. The rays do not show the same variation found in the dorsal spines, the number being the same for localities north and south. The average number of dorsal spines and rays combined consequently increases with the dorsal spines.

TABLE VIII.

Locality.	Number of specimens.	Average number of dorsal rays.	Number of specimens with 13.	Number of specimens with 14.	Number of specimens with 15.	Number of specimens with 16.	Number of specimens with 17.	Av. num. of dorsal rays & spines.
Torch Lake	7	15		1	5	1		$29\frac{4}{7}$
Cedar Rapids, Ia	1	15			1			29
White River, at Indianapolis	1	16				1		30
Gosport, Ind	5	15			5			$29\frac{4}{5}$
Bean Blossom, Ind	17	$15\frac{16}{17}$			2	14	1	$30\frac{5}{17}$
Rushville, Ind	1	15			1			29
Wild Cat Creek, Ind	1	16				1		31
Pike Creek, Ind	2	16				2		$30\frac{1}{2}$
Illinois	1	14		1				29
Nipisink Lake, Ill	2	15			2			$29\frac{1}{2}$
Monongahela River	1	15			1			30
Hartford, Ky	4	$15\frac{1}{4}$		1	1	2		$30\frac{1}{4}$
Green River, Greensburg, Ky	3	$15\frac{1}{3}$			2	1		$30\frac{1}{3}$
Little Barren River, Osceola, Ky	4	15		1	2	1		30
Little South Fork Cumberland River, Wayne Co., Ky	1	15			1			31
Eagle Creek, Olympus, Tenn	2	$14\frac{1}{2}$		1	1			31
Obeys River, Elizabethtown, Tenn	13	$14\frac{12}{13}$		3	9		1	$31\frac{5}{13}$
Watauga River, " "	2	16				2		$31\frac{1}{2}$
North Fork Holston River, Saltville, Va	1	15			1			31
Eureka Springs, Ark	1	15			1			31
Chocola Creek, Oxford, Ala	4	16			2		2	$31\frac{1}{2}$
San Marcos Spring, Tex	2	15			2			$28\frac{1}{2}$

Table IX gives similar data on the anal fins. The spines are not given since they were found to be two in all cases examined. In the anal rays we have, as in the dorsal spines, a slight increase in their number from north to south. The

most common number in the Indiana streams is ten, the number increasing to eleven and twelve in the most southern specimens.

TABLE IX.

Locality.	Number of specimens.	Average number of anal rays.	Number of specimens with 10 rays	Number of specimens with 11 rays	Number of specimens with 12 rays
Torch Lake	7	$10\frac{1}{7}$	6	1	
Cedar Rapids, Ia	1	12			1
White River, at Indianapolis	1	10	1		
Gosport, Ind	5	10	5		
Bean Blossom, Ind	17	$10\frac{9}{17}$	8	9	
Rushville, Ind	1	10	1		
Wild Cat Creek, Ind	1	11		1	
Pike Creek, Ind	2	11		2	
Illinois	1	10	1		
Nipisink Lake, Ill	2	$10\frac{1}{2}$	1	1	
Monongahela River	1	10	1		
Hartford, Ky	4	$10\frac{1}{4}$	3	1	
Green River, Greensburg, Ky	3	$10\frac{2}{3}$	1	2	
Little Barren River, Osceola, Ky	4	11		4	
Little South Fork Cumberland R., Wayne Co., Ky.	1	11		1	
Eagle Creek, Olympus, Tenn	2	11		2	
Obeys River, Elizabethtown, Tenn	13	$11\frac{6}{13}$	1	5	7
Watauga River, " "	2	$10\frac{1}{2}$	1	1	
North Fork Holston River, Saltville, Va	1	12			1
Eureka Springs, Ark	1				
Chocola Creek, Oxford, Ala	4	$11\frac{1}{4}$		3	1
San Marcos Springs, Tex	2	11		2	

Synonymy, Bibliography and Distribution of Etheostoma Caprodes Rafinesque.

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Fish. from Monongahela R., 1886; Jenkins, Proc. Terre Haute Sci. Soc., 1886. (Streams of Vigo Co., Ind.); Evermann & Jenkins, Proc. U. S. Nat. Mus., 1888, 51–57. (Tippecanoe R., Wabash R., Deer Cr., Little Deer Cr., Wild Cat Cr., Fourteen Mile Cr., Clarke Co., Ind.); Meek, Proc. U. S. Nat. Mus., XI, 1888, 440. (Maumee R., Defiance Co., O.); Jordan, Bull. U. S. Fish Com., 1888, 147, 153, 159, 164, 167. (White R., at Spencer, Ind.); Mackey's Ferry, Posey Co., Ind; Wabash R., Vincennes, Ind.; Patoka R., at Patoka, Gibson Co., Ind.; Black R., New Harmony, Ind.; Wabash R., at New Harmony, Ind.; Eel River, Logansport, Ind.; Swannanoa R., at Asheville, N. C.; Watauga R., Elizabethton, Tenn.; North Fork of Holston R., (near Glade Spr.,Va.); Bollman, Bull. U. S. Fish Com., 1888, 224. (Cognac and Torch Lakes, Mich.; Spencer Cr., Calhoun Co., Mich.); Henshall, Journ. Cin. Soc. Nat. Hist., 1888, 80. (Little Miami R., and Ross L., O.); Meek, Bull. U. S. Fish Com., IX, 1889, 123, 128, 130, 139. (Gasconade R., at Arlington, Mo.; Spadra Cr., at Clarkesville, Ark.; James R., near Springfield, Mo.); Gilbert, Bull. U. S. Fish Com., 1889, 151, 155. (Ala. R., Tenn. R.); Jordan, Bull. U. S. Fish Com., 1889, 18. (Arkansas R., at Wichita); Jordan, Man. Vert., 1890, 126. (Gr. Lakes to Va., Ala. and Texas); Kirsch, Bull. U. S. Fish Com., 1891, 260, 261, 262, 264, 265, 266, 268. (Southern Trib. Cumb. R. in Tenn. and Ky.); McCormick, Lab. Bull. No. 2, Oberlin College, O., 1892. (Waters of Loraine Co., O.); Evermann & Kendall, Bull. U. S. Fish Com., 1894, 84, 88, 93, 113, pl. XXXV. (Long L., near Magnolia Point; Nechec R., east of Palestine.)

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Perca nebulosa DeKay, "Fishes of N. Y., 1842, 7."

Etheostoma nebulosa Storer, "Synop. Fish N. A., 1847, 270–272."

Pileoma semifasciatum DeKay, N. Y. Fauna Fish., 1842, pl. 50, 162; Günther, I, 76, 1859. (Lake Erie and Ohio.)

Etheostoma semifasciata Storer, "Synop. Fish N. A., 1847, 270–272."

Percina semifasciata Girard, Proc. Acad. Nat. Sci., Phila., 1859, 66; Gill, Proc. Acad. Nat. Sci, Phila.. 1860, 20.

Pileoma carbonaria Baird & Girard, "Proc. Acad. Nat. Sci., Phila.," 1853, 387; Girard, U. S. and Mex. Bound. Surv., 10, 1859, pl. VIII, fig. 10–13. Rio Salado, Rio Medina, San Pedro Cr., Tex.); Günther, I, 76, 1859. (Rio Salado, Tex.)

Percina carbonaria Girard, "Proc. Acad. Nat. Sci., Phila., 1859, 67;" Jordan, Proc. Acad. Nat. Sci., Phila., 1877, 54. (Alabama R.); Jordan, Bull. U. S. Nat. Mus. No. 10, 1878, 15. (Texas); Jordan, Ann. N. Y. Lyc. Nat. Hist., 1878, XI, 312. (Alabama R.); Jordan, Bull. U. S. Geo. Surv., 1879, 438. (Texas).

Percina caprodes carbonaria Cope, Bull. 17, U. S. Nat. Mus., 1880, 31. (Trinity R., near Dallas, and Llano R., Kimble Co., Tex.)

Percina bimaculata Haldeman, "Proc. Bost. Soc. Nat. Hist., 1843, 157."

Etheostoma bimaculata Storer, "Synop. Fish N. A., 270–272, 1847."

Pileoma zebra Agassiz, Lake Superior, 308, pl. 4, fig. 4, 1850. (Lake Superior.)

Percina zebra Girard, Proc. Acad. Nat. Sci., Phila., 1859, 66. (Lake Superior); Jordan Bull. U. S. Nat. Mus. No. 10, 1877, 15. (Gr. Lake Region.)

Asproperca zebra Heckel.

Percina caprodes zebra Jordan, Ann. Rept. Com. Fish and Fisheries, 1884, 79.

Percina manitou Jordan, Proc. Acad. Nat. Sci., Phila., 1877, 53. (Lake Manitou in N. Indiana); Jordan, Bull. U. S. Nat. Mus. No. 10, 1877, 15. (Indiana to Minnesota); Jordan, Bull. 2 Ills. State Lab. Nat. Hist., 1878, 3. (L. Manitou, Ind., Wis.); Jordan, Bull. U. S. Geo. Surv., 1879, 438. (Indiana to Minne-

sota); Jordan, Geo. Surv. of Ohio, IV, 1878, 971. (Lakes of N. Ind., Mich. and Wis.)

Percina caprodes manitou Jordan & Gilbert, Syn. Fish. N. Am., 500, 1883. (Potomac R., Ills., Wis.); Jordan, Man.Vert., 1890, 126. (E. and N. U. S.)

To illustrate the distribution, the localities contained in the works quoted in the bibliography have been marked in the accompanying map.

The localities from which I examined specimens have been marked ♂. The areas inhabited by the various color patterns, as determined by my specimens, and by reports containing sufficiently minute descriptions, are indicated on the map by broken lines. The patterns distributed in each area is indicated by the number of the figure in the plates representing the pattern. In some cases it could not be determined which pattern occurred at the locality. There are some localities on the map, therefore, that are not included in any of the marked areas.

In conclusion, it may be observed:

1. The variation between specimens of the same locality is very slight.

2. The most complicated color pattern can be connected with the simplest by a series of intermediate stages.

3. The variation in color pattern cannot be connected with the latitude inhabited by the different varieties. The color variation is determined, but not in a direct line north and south.

4. The simplest color pattern of the body, found only in immature specimens, consists of nine transverse bars.

5. The simplest color pattern of adults consists of the nine bars seen in the young plus half bars between each two of the primary bars.

6. The next complication arises by the addition of quarter bars. These bars are first introduced in the region between the two dorsals, from which region variation seems to radiate.

7. Another complication may be the splitting of the bars into reticulations on the back and their intensification into larger spots along the sides.

8. Another modification is brought about by the shifting of the the lower half of the whole bars backward, which thus become separated from the dorsal halves. In this, the northernmost variety, the nape is naked.

9. In the simplest pattern, the two sides are usually symmetrical. If unsymmetrical, the asymmetry is introduced in the region of the spinous dorsal fin by a shifting forward or backward of the bars of one side in this region.

10. In the more complicated patterns the asymmetry has become the rule, and has spread along the region of both dorsals.

11. The variation in the combination of dorsal spines and rays is promiscuous.

12. The variation in the number of dorsal rays is promiscuous.

13. The variation in the number of dorsal spines is determinate. The southern specimens having a larger number of spines. Exception: the specimens from San Marcos Spring, Texas.

14. The variation in the number of anal rays is also determinate. As in the case of the dorsal spines, the number varies with the latitude, the southern specimens having a slightly larger number of rays.

Explanation of Plates.

Fig. 1. *Etheostoma caprodes Rafinesque,* 33 mm., Chocola Cr. Oxford, Ala.

Fig. 2. *Etheostoma caprodes Rafinesque,* 83 mm., Bean Blossom, Ind.

Fig. 3. *Etheostoma caprodes Rafinesque,* 88 mm., Chocola Cr., Oxford, Ala.

Fig. 4. *Etheostoma caprodes Rafinesque,* 102 mm., Green R., Greensburg, Ky.

Fig. 5. *Etheostoma caprodes Rafinesque,* 115 mm., San Marcos, Spr., Tex.

Fig. 6. *Etheostoma caprodes Rafinesque,* 88 mm., Torch Lake, Mich.

Fig. 7. *Etheostoma caprodes Rafinesque,* 86 mm., Obeys R., Elizabethtown, Tenn.

Fig. 8. *Etheostoma caprodes Rafinesque,* 115 mm., Lit. S. Fork Cumberland R., Wayne Co., Ky.

Fig. 9. *Etheostoma caprodes Rafinesque,* 60 mm., Gosport, Ind.

Fig. 10. *Etheostoma caprodes Rafinesque,* 85 mm., Obeys R., Elizabethtown, Tenn.

Fig. 11. *Etheostoma rex* Jordan.

Explanation of Map.

2. Pattern 2.
3. " 3.
4. " 4.
5. " 5.
6. " 6.
11. *Etheostoma rex* Jordan.

NEO-LAMARCKISM AND NEO-DARWINISM.[1]

By L. H. Bailey.

It is difficult to accept the hypothesis of organic evolution in the abstract. In the first place, there must be some reason for the operation of a law of transformation or development; and this is found in the ever-changing physical or external conditions of existence, which are more or less opposed to established organisms. And it may also be said that the very fact of the increase of organisms through multiplication must impose new conditions of competition upon every succeeding generation. Again, it is necessary to conceive of some means or machinery by which the process of evolution is carried forward. It was long known that all species vary, that is, that no two individuals in nature are exactly alike; yet there was lacking any hypothesis to show either why these varieties appear or how it is that some become permanent and some do not. The first scientific explanation of the process of evolution was that made in 1809 by the now famous Lamarck. He saw two factors which, he thought, were concerned in the transformation of species—the habitat and the habit. The habitat is the condition in which the organism lives, the environment. This environment, subject to change with every new individual, calls for new habits to adapt the organism to the new needs—inducing greater exercise of some powers or organs and less exercise of others. This greater or less use gradually strengthens or enfeebles the organ concerned, and the modifications thus acquired are preserved "through heredity to the new individuals that are produced by them, provided the changes are common to the two sexes, or to those that have produced these new individuals." There are three things to be considered in this hypothesis: 1. Changes in environment or the conditions of life react upon organisms in the direction of their needs or functions. 2. Organs or powers thus affected are modified to satisfy the new demands. 3. The modifications

[1] Extract from an address before the Philosophical Club of Cornell University.

acquired by the individual are hereditary. This, then, is Lamarckism—that the controlling factor or process in evolution is functional, and that acquired characters are readily transmissible. It is important that I still repeat Lamarck's belief in the transmission of a character obtained by any individual during its own lifetime, for this is the starting point of the definition of an "acquired character" concerning the heredi-tability of which the scientific world is now rent. "All that nature has caused individuals to acquire or lose through the influence of the circumstances to which their race has been for a long time exposed," says Lamarck, "it preserves," etc. And again, "Every change acquired in an organ by a habitual exercise sufficient to have brought it about, is preserved thereafter through heredity," etc. We shall presently observe how far this definition of an acquired character has been maintained by recent philosophers.

Just fifty years after the publication of Lamarck's theory, Darwin proposed a hypothesis which has had a greater influence upon the habit of scientific thought than any enunciation since the promulgation of inductive philosophy. Darwin, like Lamarck, saw that all forms of life vary; and like him, too, he perceived that there must be a fierce struggle for place or existence amongst the individuals of the rapidly succeeding generations. This variation and struggle are particularly apparent in cultivated plants; and Darwin saw that the gardener selects the best, and thereby "improves" the breed. "Can it, then, be thought improbable," says Darwin, "seeing that variations useful to man have undoubtedly occurred, that other variations useful in some way to each being in the great and complex battle of life, should occur in the course of many successive generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind?" "This preservation of favorable individual differences and variations, and the destruction of those which are injurious, I have called Natural Selection, or the Survival of the Fittest." This, then, is Darwinism—that the

controlling factor or process in evolution is selective: the survival, in the struggle for existence, of those individuals which are best fitted to survive. But while this is the naked core of Darwinism, there are various correlative or incidental hypotheses attached to it. Darwin, for instance, accepted in some degree the views of Lamarck as to the importance of functional characters; he considered that sexual selection, or the choice exercised in securing mates, is often an important factor in modifying species; he thought that variation is induced by the modifications of environment, or the "changed conditions of life;" and he was a firm believer in the hereditability of acquired characters. It is around these two great hypotheses—the functional or Lamarckian on the one hand, and the selective or Darwinian upon the other—in various forms and modifications, that the discussions of the philosophy of organic nature are at present revolving.

Before leaving the subject of Darwinism, I wish to touch upon Darwin's view of the cause of variation and his belief in the transmission of acquired characters. We shall presently see that the rehabilitation of the theories of Lamarck, under the name of Neo-Lamarckism, is undertaken, very largely, for the purpose of assigning the origin of variations to external causes, or to the environment, in opposition to those who consider the source of variation to be essentially innate or at least internal. But Darwin also believed that variation is induced by the environment, and the chief factor in this environment, so far as its reaction upon the organism is concerned, is probably excess of food supply, although climate, and other impinging circumstances, are potent causes of modification. He marshalled arguments to support "the view that variations of all kinds and degrees are directly or indirectly caused by the conditions of life to which each being, and more especially its ancestors, have been exposed," and that "each separate variation has its own proper exciting cause." I do not understand how it has come about that various writers declare that Darwin did not believe explicitly in the external cause of variation, and that they feel obliged to go back to Lamarck in order to find a hypothesis for the occasion. It is true that Darwin be-

lieved that the nature or direction or particular kind of variation in a given case, is determined very largely by the constitution of the organism, but variation itself, that is, variability, proceeds largely from external causes; and the characters arising in the lifetime of an individual may become hereditary. I must hasten to explain, however, that Darwin clearly recognized the importance of the union of sexes, or crossing, as a cause of variation.

While Darwin believed that the effects of variability arise "generally from changed conditions acting during successive generations," he nevertheless believed that the first increment of change—that arising in the first individual of a given series—might be directly carried over to the first offspring. That is, he believed in the hereditability of acquired or new external characters, a fact which is emphasized by his conviction that certain mutilations, and even the effects of use and disuse, may be transmitted. Yet, whilst Darwin accepted the doctrine, he believed it much less thoroughly than Lamarck did, and it is but an incidental part of his philosophy, while it is an essential tenet of Lamarckism.

Thus far, the heriditability of all important characters had not been disputed. In other words, heredity as a general law or force in the organic world, had been assumed. But with the refinement of the discussions it became necessary to conceive of some definite means through which the transmission of particular characters or features should operate; and it was soon found, also, that no philosophy of evolution can expect to explain the phenomena of organic life unless it is connected and co-ordinated with some hypothesis of the method of heredity. While, therefore, a hypothesis of heredity need not necessarily be associated with the abstract theory of evolution, all such hypotheses which are now before the scientific world have for their particular object the explanation of the assumed progressive tendency of the forms of life.

It is incomprehensible that the minute fertilized ovum or ovule should reconstruct the essential characters of the two individuals from which it proceeds, unless it has in some way derived distinct impressions from every part and organ of the

parental bodies which it reproduces. It would seem as if it must of itself be an epitome or condensation of its parents, with the power of unfolding its impressions or attributes during the whole life course of the organism to which it gives rise. Several hypotheses have been announced to account for the phenomena of heredity, of which, one of the most important is still Darwin's theory of pangenesis. Darwin supposed, provisionally, that besides the ordinary multiplication of the cell, each cell may "throw off minute granules which are dispersed throughout the whole system; that these, when supplied with proper nutriment, multiply by self-division, and are ultimately developed into units like those from which they were originally derived." These granules, or gemmules, have a natural affinity for each other, and they collect themselves "from all parts of the system" to form the sexual materials or elements. These sexual elements, therefore, which unite to form the new individual, are an epitomized compound of the parents. The value of this hypothesis, it seems to me, lies not so much in the particular constitution and behavior of these gemmules, as in the fact that it attempts to account for the known phenomena of life by supposing each corporeal element to be represented in the sexual elements. The hypothesis has never gained wide support, because of the supposed physical improbability of the gemmules and of their concentration in sexual system; yet it should be said that a simpler one, which can account for the facts, has not yet been advanced, unless it be the bathmic hypothesis of Cope, which supposes that each body-cell transmits "a mode of motion" to the germ-cell.

For the present purpose, we need consider but one other hypothesis of heredity—that advanced in 1883 by Weismann, which has given rise to the philosophy now called Neo-Darwinism. Weismann's point of view is interesting and unique. He places himself at the threshold of organic life and contemplates what takes place in the reproduction of one-celled organisms. These organisms multiply largely by simple division, or fission. When the organism reaches a certain size, it becomes constricted near its middle, and finally parts into two cells or organisms. It is evident that one organism is twin

of the other, neither is older, neither is parent, but each has partaken of the common stock of protoplasm. The protoplasm again multiplies itself in the two organisms, and at length it is again divided; and so, to the end of time, the remotest individual of the series may be said to contain a portion of the original protoplasm; in other words, the protoplasm is continuous. And inasmuch as protoplasm is the seat or physical basis of life, it may be said that the one-celled organism is immortal, or is not confronted by natural death.

In time, however, there came a division of labor—cells living together in colonies, and certain cells performing one function and certain other cells other functions. This was, perhaps, the beginning of the many-celled organism, in which certain cells developed the specific function of reproduction, or eventually became elements of sex. As organisms became more complex in their structure, there came to be great differences between this reproductive or germ portion and the surrounding or body portion; and Weismann assumes that these two elements are different and distinct from each other in kind, and that inasmuch as the one-celled organisms propagated their exact kind by simple division, that therefore the reproductive elements of the many-celled or complex body must continue to perpetuate their kind or enjoy immortality, while all the surrounding or body cells die and are reproduced only through the reconstructive power of the sexual elements. There are, then, according to this hypothesis, two elements or plasms in every organized being, the germ-plasm and the soma-plasm or body-plasm; and every organism which procreates thereby preserves its germ-plasm to future generations, while death destroys the remainder. A vital point in this hypothesis is the method by which the soma-plasm, or the organs and body of the organism, can be so impressed upon the germ that they shall become hereditary. At first it would seem as if some assumption like that of Darwin's might be useful here—that this germ-plasm is impressed by particles thrown off from all the surrounding or soma-cells; but this Weismann considers to be too unwieldy, and he ascribes the

transfer of these characters through the medium of the germ-plasm to "variations in its molecular constitution." In other words, there can be no heredity of a character which originates at the periphery of the individual, because there is no means of transferring its likeness to the germ. All modification of the offspring is predetermined in the germ-plasm; and if the new organism becomes modified through contact with external agencies, such modification is lost with the death of the individual. "Characters only acquired by the operation of external circumstances acting during the life of the individual, cannot be transmitted." "All the characters exhibited by the offspring are due to primary changes in the germ." It is admitted that the continued effect of impinging environment may, now and then, finally reach the germ-plasm, but not in the first generation in which such extraneous influence may be exercised. In other words, acquired characters cannot be hereditary.

It would seem as if this hypothesis precluded the possibility of evolution or the continued modification of species, inasmuch as it does not accept the modifications arising directly from external sources. But Weismann supposes that variation originates—or at least all variation which is of permanent use to the species—from a union of the sexes, inasmuch as the unlike germ-plasms of two individuals unite; and from the variations thus induced are derived the materials upon which natural selection works in the struggle for existence. "I am entirely convinced," Weismann writes, "that the higher development of the organic world was only rendered possible by the introduction of sexual reproduction." "Sexual reproduction has arisen by and for natural selection, as the only means by which the individual variations can be united and combined in every possible proportion."

It will be seen that Weismann is a Darwinian—a believer in natural selection as the one controlling process of evolution; but, unlike Darwin, he refers variation to sex and declares that any new or acquired character originating in the body of the organism cannot be transmitted. The exact means or machinery through which he supposes heredity to act, is rather

more an embryological matter than a philosophical one. We are particularly concerned in its results, which are the distinguishing marks of Neo-Darwinism—that variation is of sexual or internal origin, and that acquired characters are not hereditary.

In opposition to this body of belief, which has been upheld, particularly in England, with much aggressiveness, is Neo-Lamarckism, which is a compound of both Lamarckism and Darwinism, and which has an especially strong following in North America. The particular canons of this philosophy are the belief that external causes, or the environment, are directly responsible for much variation and that acquired characters are often hereditary. Other features of it, held in varying degrees by different persons, are the belief in the transforming effects of use and disuse, and in natural selection.

The one great schism between the Neo-Darwinians and the Neo-Lamarckians is the controversy over the hereditability of acquired characters, and just at present this question has come so strongly to the fore that other differences in the two hypotheses have been obscured. It is worthy of remark that Darwinism or Neo-Lamarckism sees first the facts or phenomena and then tries to explain them; while Neo-Darwinism or Weismannism assumes first a hypothesis and then tries to prove it. I think that any one will be struck with this difference of attitude, if he read Darwin's chapter upon pangenesis, and then read Weismann's essay upon heredity. The Neo-Darwinians are loud in demand of facts or proof that acquired characters are hereditary, and they attempt to throw the burden of proof upon their opponents; while, at the same time, they give no proofs of their own position, and confound their adversaries with verbal subtleties. The burden of proof, however, lies clearly upon the Neo-Darwinians, inasmuch as they have assumed to deny phenomena which were theretofore considered to be established.

A voluminous issue of polemics has occurred during the last five or six years between the Neo-Darwinians and the Neo-Lamarckians; but whatever may have been its effects upon the older philosophy, it is clear, to my mind, that some of the

attacks upon Neo-Darwinism are unanswerable in any rational manner, and it is certain that they have forced Weismann into a change of position with reference to some of his definitions. Certain phases of this discussion appeal with particular force, of course, to some minds, while they exert little influence upon others. My own objections to Neo-Darwinism—and I admit that my bias is strong against it—seem to be somewhat different from those most commonly urged in opposition to it; and the three which chiefly influence me I shall present very briefly.

1. I cannot see that the non-transmissibility of acquired characters is a necessary assumption to Weismann's fundamental arguments. I have already explained his reasoning from the reproduction of the one-celled organism. I cannot attempt any opinion of the probable facts upon which the hypothesis is founded. It may be said, in passing, that one of the prominent objections to the fundamental basis of the theory is the difficulty of deriving the mortal soma-plasm from the immortal germ-plasm, a question to which, however, Weismann has made a somewhat full reply.

When organisms became complex, it was necessary to assume either that the soma-plasm does or does not directly influence the germ-plasm. Weismann discarded the various hypotheses which suppose that there is a vital and necessary connection between the body units and reproductive units, and then to avoid the difficulties which the hereditability of acquired characters would entail, he supposed that such characters are not hereditary. His subsequent labors have been largely employed in trying to show that they are not. This supposition was made for the purpose of simplifying the hypothesis by removing the cumbrous gemmules of Darwin and the similar bodies or movements of other philosophers, and therefore by localizing the seat of the germ-plasm. But he immediately encounters difficulties quite as great as those which he avoids. In cases where there are alternate generations of asexual and sexual organisms, he must suppose that the germ-plasm is united with the soma-plasm, and is probably, therefore, distributed throughout the body. "There may be in fact cases," Weismann writes,

"in which such separation [of the germ-plasm from the soma-plasm] does not take place until after the animal is completely formed, and others, as I believe that I have shown, in which it first arises one or two generations later, viz., in the buds produced by the parent." And he has been compelled to admit that in the case of begonias, which are propagated by leaves, the germ-plasm is probably distributed throughout the foliage; and he must make a similar admission for all plants, for they can all be propagated and modified through asexual parts. This is admitting, then, that there is no localized germ-plasm in the vegetable kingdom and in some instances in the animal kingdom; and if the germ-plasm is distributed to the very periphery of the organism, why may it not be directly affected by environment, the same as the soma-plasm is? Or why is the hypothesis any the less objectionable than Darwin's pangenesis, which supposes that every organic unit can communicate with the germ?

Weismann also supposes, as I have said, that the means by which the germ-plasm is able to reconstruct the soma-plasm in the offspring, is through some modification in its "molecular constitution," an assumption which was by no means novel when Weismann announced it. "The exact manner in which we imagine the subsequent differentiation of the colony to be potentially present in the reproductive cell," he writes, "becomes a matter of comparatively small importance. It may consist in a different molecular arrangement, or in some change of chemical constitution, or it may be due to both these causes combined." In whatever manner the germ-plasm receives its somatic influences, there must be a direct connection between the two, and it is quite as easy to assume the existence of gemmules as any less tangible influence. I am not arguing in favor of pangenesis, but only stating what seems to me to be a valid objection to the fundamental constitution of the Weismannian hypothesis—that it is quite as easy to assume, from the argument, one interpretation of the process or means of heredity as another. And if there is any vital connection whatever between the soma-plasm and the germ-plasm—as the

hypothesis itself must admit—then why cannot the soma-plasm directly influence the germ-plasm?

Again, I wish to point out that modification and evolution of vegetable species may and does proceed wholly without the interposition of sex—that is, by propagations through cuttings or layers of various parts. This proves either one of two things—that the germ-plasm is not necessary to the species, or else that it is not localized but distributed throughout the entire body of the individual, as I have shown above; and either horn of this dilemma is fatal, it seems to me, to Weismannism. If the germ-plasm is not necessary to this reproduction, then we must discard the hypothesis of the continuity of the germ-plasm; if the germ-plasm is distributed throughout the plant, then we are obliged to admit that it is not localized in germ-cells beyond the reach of direct external influences.

This sexual propagation of plants has been brought to Weismann's attention by Strasburger, who cited the instance of the leaf-propagation of begonia, and said that plants thus asexually multiplied afterwards produce flowers and seeds, or develop germ-plasm. Weismann meets the objection by supposing that it is possible for "all somatic nuclei to contain a minute fraction of unchanged germ-plasm," but he considers the begonia, apparently, to be an exception to most other plants, inasmuch as he declares that "no one has ever grown a tree from the leaf of the lime or oak, or a flowering plant from the leaf of the tulip or convolvulus." Henslow meets this latter statement by saying that this has not been accomplished simply because "it has never been worth while to do it. If, however, a premium were offered for tulips or oak-trees raised from leaf-cuttings, plenty would soon be forthcoming." What Weismann wishes to show is that the begonia is an exception to other plants in allowing of propagation from leaf-cuttings, although he should have known that hundreds of plants can be multiplied in this way, and that—what amounts to the same thing—all plants can be propagated by asexual parts, as stems or roots.

But there is another aspect to this asexual multiplication of plants which I do not remember to have seen stated in this

connection. It has been said that the asexually multiplied plants may afterwards produce flowers and resume the normal method of reproduction and variation. I now wish to add what I have already said, that plants may be continuously multiplied asexually and yet the offspring may vary, and the variations may be transmitted from generation to generation, quite as perfectly as if seed production intervened. This has been true with certain plants through a long period of time, as the banana, and every intelligent gardener knows that plants propagated by cuttings often "sport" or vary. Here are cases, then, in which variation does not originate from sex, unless Weismann is willing to concede that the result of previous sexual union has remained latent through any number of generations and has been carried to all parts of the plant by a generally diffused germ-plasm; and if this is admitted, then I must again insist that this germ-plasm must be just as amenable to external influences as the soma-plasm with which it is indissolubly associated. I have repeated this argument in order to introduce the subject of "bud variations," or those "sports" which now and then appear upon certain limbs or parts of plants and which are nearly always readily propagated by cuttings. These variations cannot be attributed to sex, in the ordinary and legitimate application of the Weismannian hypothesis. Whilst these "sports" are well known to horticulturists, they are generally considered to be rare, but nothing can be farther from the truth. As a matter of fact, every branch of a tree is different from every other branch, and when the difference is sufficient to attract attention, or to have commercial value, it is propagated and called a "sport." This leads me to recall the old discussion of the phytomer, or the hypothesis that every node and internode of a tree—and we might add the roots—is in reality a distinct individual, inasmuch as it possesses the power of leading an independent existence when severed from the plant, and of reproducing its kind. However this may be as a matter of of speculation, it is certainly true as regards the phenomenon, and shows conclusively that if the germ-plasm exists at all, it exists throughout the entire structure of the plant.

This conclusion is also unavoidable from another consideration—the fact that plants are asexual organisms at all times previous to flowering, and the germ-plasm must be preserved, in the meantime, along with the soma-plasm. But this conclusion is inconsistent with Weismannism as taught at present, and this alone would lead me to discard the hypothesis for plants, however well it may apply to the animal kingdom.

Henslow has made a different argument to show that the germ-plasm of plants may be directly exposed to external influence (*Origin of Floral Structures*). The germ-plasm is assumably located in the flower, and the egg-cell of the embryo-sac and the sperm-cell of the pollen grain are close to the surface, and are directly impressed by the interference of bees and other external stimuli. Henslow endeavors to show "that the infinite variety of adaptations to insects discoverable in flowers may have resulted through the direct action of the insects themselves, coupled with the responsive power of protoplasm." And these characters must be in part acquired during the lifetime of a given individual.

2. It seems to me, also, that the presumption, upon general philosophical grounds, is against the doctrine that immediate external influences are without permanent effect. If we admit—as all philosophers now do—that species are mutable, and that the forms of life have been shaped with reference to their adaptations to environment, then we are justified in assuming that every change in that environment must awaken some vital response in the species. If this response does not follow, then environment is without influence upon the organism; or if it follows and is then not transmitted, it is lost just the same, and environment is impotent. And it does not matter if we assume, with the Neo-Darwinians, that this effect does not become hereditary until the germ is affected—that is, until two or more generations have lived under the impinging environment—it must nevertheless follow that the change must have had a definite beginning in the lifetime of an individual; for it is impossible to conceive that a change has its origin in two generations. In other words, the beginning is singular; two generations is plural. And whether the modification is di-

rectly visible in the body of the organism or is an intangible force impressed upon the germ, it is nevertheless an environmental character, and was at first acquired. If this is not true—that the changed conditions of life exert a direct effect upon the phylogeny of the species—then no variation is possible save that which comes from the recompounding of the original or ancestral sex-elements; and it would still be a question how these sex-elements acquired their initial divergence.

The Neo-Darwinians would undoubtedly meet this argument by saying that their hypothesis fully admits the importance of these external influences, the only reservation being that they shall have affected the germ. It is true that this is a common means of escape; but it cannot be gainsaid that the denial of the influence of the external or environmental forces is really the fundamental difference between them and the Darwinians or Neo-Lamarckians, as the following quotation from Weismann will show: "Our object is to decide whether changes in the soma (the body, as opposed to the germ-cells) which have been produced by the direct action of external influences, including use and disuse, can be transmitted; whether they can influence the germ-cells in such a manner that the latter will cause the spontaneous appearance of corresponding changes in the next generation. This is the question which demands an answer; and, as has been shown above, such an answer would decide whether the Lamarckian principles of transformation must be retained or abandoned."

If, then, to repeat, organisms are adapted to their environment, it must be equally true that this environment directly affects its inhabitants; and considering the intense struggle for existence under which all organisms live, it is highly probable that any advantageous variation can be seized upon at once. I cannot conceive that nature allows herself to lose the result of any effort.

3. My third conviction against Neo-Darwinism arises from the fact that its advocates are constantly explaining away the arguments of their opponents by verbal mystifications and ingenious definitions. This charge is so frequently made, and

the fact is so well known, that it seems almost useless to refer to it here; and yet there are some phases of it upon which I cannot forbear to touch.

Weismann declares that he uses the term "acquired character" in its original sense. This term, or at least the idea, was first employed, as we have seen, by Lamarck, who used it or an equivalent phrase to designate "every change acquired in an organ by a habitual exercise sufficient to have brought it about." In fact, the basis of Lamarck's philosophy is the assumption of the hereditability of characters arising directly from use or disuse; and his idea of an acquired character is, therefore, one which appears in the lifetime of the individual from some externally inciting cause. Darwin's notion, while less clearly defined, was essentially the same, and he collected a mass of evidence to show that such characters are transmissible; and he even went farther than Lamarck, and attempted to show that mutilations may be hereditary. Weismann's early definition of acquired characters is plain enough. Such characters, that is, the somatogenic, "not only include the effects of mutilation, but the changes which follow from increased or diminished performance of function, and those which are directly due to nutrition and any of the other external influences which act upon the body." Standing fairly and squarely upon this definition, it is easy enough to disprove it —that is, to show that some characters thus acquired are hereditary. But the moment proofs are advanced, the definition is contracted, and the Neo-Darwinians declare that the given character was potentially present in the germ and was not primarily superinduced by the external conditions—a position which, while it allows of no proof, can neither be overthrown. A cow lost her left horn by suppuration, and two of her calves had rudimentary left horns; but Weismann immediately says, "The loss of a cow's horn may have arisen from a congenital malformation." Certainly! and it may not; and the presumption is that it did not. A soldier loses his left eye by inflammation, and two of his sons have defective left eyes. Now, "the soldier," says Weismann, "did not lose his left eye because it was injured, but because it was predisposed to become

diseased from the beginning, and readily became inflamed after a slight injury"! This gratuitous manner of explaining away the recorded instances of the supposed transmission of mutilations and the like, is common with the Neo-Darwinians, but it must always create the impression, it seems to me, of being labored and far-fetched; and inasmuch as it is incapable of proof, and is of no occasion beyond the mere point of upholding an assumed hypothesis, it is scarcely worthy serious attention. It would be far better for the Neo-Darwinians if they would flatly refuse to accept the statements concerning the transmission of mutilations, rather than to attempt any mere captious explanation of them; for it is yet very doubtful if the recorded instances of such transmissions will stand careful investigation.

But perhaps the most remarkable example of this species of Neo-Darwinian logic is produced by Weismann when he is hard pressed by Hoffmann, who supposed that he had proved the hereditability of certain acquired characters in poppies. Weismann says: "Since the characters of which Hoffmann speaks are hereditary, the term cannot be rightly applied to them;" thus showing that his fundamental conception of an acquired character is one which cannot be transmitted! He then proceeds to elaborate this definition as follows: "I have never doubted about the transmission of changes which depend upon an alteration in the germ-plasm of the reproductive cells, for I have always asserted that these changes, and these alone, must be transmitted." Then he proceeds to say that it is necessary to have "two terms which distinguish sharply between the two chief groups of characters—the primary characters which first appear in the body itself, and the secondary ones which owe their appearance to variations in the germ, however such variations may have arisen. We have hitherto been accustomed to call the former 'acquired characters,' but we might also call them 'somatogenic,' because they follow from the reaction of the soma under external influences; while all other characters might be contrasted as 'blastogenic,' because they include all those characters in the body which have arisen from changes in the germ. * * * We maintain that the

'somatogenic' characters cannot be transmitted, or rather, that those who assert that they can be transmitted, must furnish the requisite proofs." That is: changes in the soma-plasm are not transmitted; acquired characters are changes in the soma-plasm; therefore, acquired characters cannot be transmitted! Or, to use Weismann's shorter phrase, "Since the characters * * * are hereditary, the term ['acquired'] cannot be rightly applied to them!" Surely, Neo-Darwinism is impregnable!

Weismannism has unquestionably done much to elucidate some of the most intricate questions of biology, and it has weeded the old hypotheses of much that was ill-considered and false. It has challenged beliefs which have been too easily accepted. Its value to the science of heredity upon its biological side is admitted, and its explanation of the meaning of sex is one of the best of all contributions to the philosophy of organic nature. It has suffered, perhaps, from too ardent champions, and its great weakness lies in its stubborn refusal to accept an important class of phenomena associated with acquired characters, a sufficient explanation of which, it seems to me, could be assumed without great violence to the hypothesis.

Most Neo-Lamarckians accept much of Weismann's teachings. But, while there are comparatively few who believe that mutilations are directly transmissible, there is a general and strong conviction that many truly acquired characters are hereditary, and there seems to be demonstrable evidence of it; and while sex variation is fully accepted, it logically follows, if acquired characters are hereditary, that much variation is due directly to external causes. Perhaps the habit of thought of most Darwinians and Neo-Lamarckians is something as follows:

All forms of life are mutable. Variation affords the material from which progress is derived. Variation is due to sexual union, changed conditions of life, panmixia or the cessation of natural selection, and probably somewhat to direct use and disuse. There is an intense struggle for existence. All forms or variations useful to the species tend to live, and

the harmful ones tend to be destroyed through the operation of the simple agent of natural selection. These newly appearing forms tend to become permanent, sometimes immediately; but the longer the transforming environments are present, the greater is the probability, on the whole, that the resulting modifications will persist.

ORNITHOPHILOUS POLLINATION.

By Joseph L. Hancock.

The position that some of the humming-birds occupy in respect to the transference of pollen from flower to flower is by no means subordinate to insects.[1]

The common ruby-throated humming-bird (*Trochilus colubris*) though not endowed with specialized structures for the specific performanee of this office, bears upon careful study evidence that the mouth parts and feathers have certain means for the harboring of pollen quite beyond the ordinary views. The anatomical peculiarities of this bird's head allows access to flowers, covering a wide range of forms. A narrowing awl-shaped cone 29 mm. long represented by a base of 10 mm. admits of this latitude, as expressed more clearly in the accompanying plate, figures 2 and 3, of the head and skull. By reason of some flexibility, the bill is capable of probing to the bottom of nearly all the forms of flowers commonly met with. In the feeding process, familiar to almost every one, the flower is often bent over to be relieved of its juices. The trumpet honeysuckle (*Lonicera sempervirens*) in the proper season, furnishes an important part of the food of *T. colubris.* This vine appears wild in the south, the corolla of the flower is long, see figure 6, red and scentless. There is a way of accounting for this latter condition. Fragrant odors are largely essential to the attraction of bees and other insects, but as this plant does not lean upon their aid for fertilization, but depends more upon the humming-bird and larger moths for the interchange of pollen, the absence of fragrance is accounted for. The two last mentioned, from my own observations, depend for the most part upon sight for the detection of food plants. A male specimen of the ruby-throated humming-bird which was taken from a cat which had seized it in the act of feeding upon the nectar of flowers, was sent to the writer by a friend. From

[1]To this power in birds the designation of *ornithophilous* pollination is proposed in contradistinction to *entomophilous* pollination.

this and other dead specimens was derived much of the present knowledge. A cursory examination with the naked eye of the head does not reveal with clear distinctness the important facts brought out by the use of the microscope, consequently this instrument was brought into use in furthering research. Pollen is carried in several ways by this bird. On the lower mandible just in front of the angle of the mouth, overshadowed by the nasal scale when the bill is closed, a faint yellowish line marks the deposit of pollen grains resting in a small groove clustered together, see figure 5 at point b. Here were found various kinds, but one small form rather irregularly round in outline predominated. Pollen-grains work their way free to the summit or vanes of the feathers about where they were seen scattered, and as will be described further on, caught up by the barbs of the feathers, along the sides of the chin and lores ready to be deposited when a more suitable surface presents. Under the lower bill, see enlarged view, figure 4, and also 5a, the deep median groove, the point of meeting of the rami, which traverses along for nearly one-half its length, acts as a second repository. This pollen repository groove becomes divided backwards on either side for a short distance. Pollen lodges in larger quantities here and can be detected deep within the median portion of the groove. It is interesting to note that pollen found deep in the recess of this part bore evidence of greater age and possibly from foreign plants unknown to me. This fact opens up a line of investigation which promises interesting results in the future. With a needle the mass of grains which cluster together can be removed and separated with care. A small mass, only a fractional part of what still remained, showed with a focus of a ¼ inch objective hundreds of pollen-grains. The long shaft of the bill also had upon its surface a few scattered ones. The most noteworthy phase of this subject remains yet to be recorded when the feathers are analyzed in greater detail, for here is to be found the real means of scattering the pollen or pollination. The chief *repositories* having been just described as occurring below the angle of the mouth and in the median

groove under the lower mandible, it remains to mention the part taken by the feathers.

There are four ways by which the pollen becomes engaged or held by the feathers, which will be better understood after the anatomy of the latter structures are touched upon. The feathers from the sides of the head, lores and below, are mainly instrumental in this work. In general they are much like feathers of other birds, of the contour type, plumulaceous at the base, composed of a short, weak calamus, a rhachis, vanes, barbs and barbules; the latter being peculiar in that at the extremity of the vane the barbules are armed with sharp, thistle-like projections (barbicels) some of which are somewhat curved. The vanes at the base of the feathers are long and thread-like, near where they join the shaft are flattened oar fashion as seen in figure 8. Little pointed barbs divide these filimentous vanes at regular short distances. One of the methods of carrying pollen is here met with between two of the vanes as shown. The vanes of the upper part of the main body of the feather, are made up of narrow acute plates or barbs resting close together. The barbs of another vane often encroach or touch the barbs of a neighboring vane, so that between them is found entrapped many pollen-grains as demonstrated in figure 7. Another way by which pollen is effectually engaged is between two of the barbs merely spread apart, giving room for the grain to be held as in figure 9. The fourth method observed of carrying these fertilizing agents is an extraneous one, depending upon the glutinous secretion from the stigma of plants that adhere to the feathers, thus assisting the pollen to stick fast to the feather. Through a high magnifying power is seen the thistle-like ending of the vanes, the barbules frequently matted together by the sticky secretion referred to, gathered from the flowers while in search of food. Attached to the many pointed and flattened surfaces were seen pollen-grains of many kinds, chiefly of very minnte size, ready to depart or taken on anew at the next visit to a flower. In anemophilous flowers in which the wind is the agency for carrying the pollen, the grains are usually small, light, more or less dry and spherical, while in entomophilous

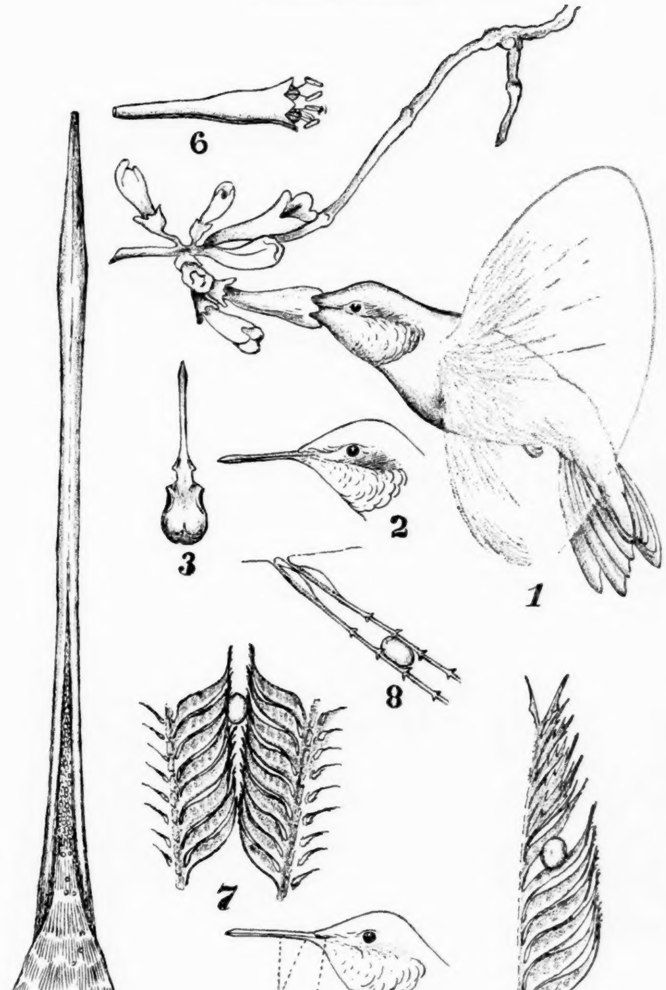
flowers, the pollen of which is carried from one plant to another by insects in search of honey, are variously adapted to cause the grains to adhere to the hairy underside of the insects body to promote their dispersion. In ornithophilous pollination the pollen is carried in such diverse ways that this together with other data combine to make it possible that the humming-bird is the most wonderful distributor of pollen known to the animal world. We are not content to leave the subject without noticing, that as compared with insects, the local range of flight of humming-birds is undoubtedly greater and during the regular migrations they make extensive flights.[2] Their summer home in eastern North America extends from the Gulf of Mexico to half way across the British Provinces and from the Atlantic Coast to beyond the Mississippi River. In winter its range is southward, reaching into Southern Florida, into Veragua and the western portion of the Isthmus of Panama, about eight degrees north of the equator. The equivalent of some 2000 statute miles is thus represented in the migrations of this diminutive bird. The pollen taken enroute during migration, as the humming-bird takes its sip of nectar from flower to flower, may gather in its repositories and be transported from place to place anywhere throughout its range. That some strange pollen grains are found entangled upon the bird is not surprising, especially in spring, taking these suggestions into consideration, and what wonder is it we are called upon to say that the phenomena of so widespread and perpetual a means of pollination of plants is perhaps unparalleled.

Explanation of Plate.

Fig. 1. *Trochilus colubris* taking food, drawn from memory.
Fig. 2. Head of *T. colubris* from nature.
Fig. 3. Skin removed from head to show skull.

[2]It will be observed that the author refers entirely to the ruby-throated humming-bird (*T. colubris*) here, and what may be brought out by a further study of other species as regards to the part they play in pollination is a matter for the future.

PLATE XXII.



Ornithophilous pollination.

Fig. 4. Enlarged ventral view of lower mandible showing pollen repository groove.

Fig. 5. Head of *T. colubris* showing *a*, side repository, *b*, repository under the lower mandible.

Fig. 6. Single flower of Trumpet Honeysuckle.

Fig. 7. Two vanes side by side, *from main part* of a feather of *T. colubris*, showing one of the ways of carrying pollen-grains.

Fig. 8. Two vanes side by side of the same feather *from the base*, showing another way of carrying pollen-grains.

Fig. 9. One-half of a vane showing thistle-like structure at end of a feather, also showing another method of carrying the pollen-grains between two barbs. Pollen adheres to these feathers by aid of the sticky secretion of plants.

EDITORIALS.

—The U. S. Geological Survey has entered on a new era of its history, and one which will have an important bearing on the study of geology in this country. We look for a material improvement in the administration of this public trust, as compared with its history during the past ten years. Major Powell, who has just retired from the position of director, tried a good many experiments which were not judicious, and proposed to try others which were fortunately suppressed. It is to be greatly regretted that the Survey did not at the outset establish a modus vivendi with either the U. S. Engineers, or the Coast and Geodetic Survey, so that the topographic work could have been done by one or the other of these competent corps of men. They possessed the plant, both in men and in apparatus, but instead of arranging with one or the other of them, director Powell preferred to expend a large part of the resources of the Survey on this branch of the work. The topographic corps of the Survey constituted, perhaps, two-thirds of the entire force, and the expenditures for it were of course proportionately great. The new director, Dr. Walcott, inherits this incubus from his predecessor. The problem of its continuation as a part of the Survey's work is a serious one, in view of the reduced appropriations now granted by Congress. It may be considered in connection with the fact, that ultimately the geology of the United States will be represented on maps of first class topographic quality. It is frequently asserted that the maps hitherto produced by the Survey have not that high accuracy which the subject demands, although not without value for general purposes. The production of the best grade of map will probably require a greater outlay than has been heretofore granted for this purpose. Since the appropriations are less than heretofore, the assumption of this work by one or the other bureaus of the Government already mentioned would seem to be a necessity.

The importance of such a transfer is obvious from another point of view. The department of paleontology was inexcusably neglected by Major Powell, who had little appreciation of its importance to geology. So far as concerns vertebrate paleontology, the Survey's publications are distinguished by their absence, as based on collections in this department, for which large sums were expended. This failure of the Survey to render any equivalent for the expenditure, led Congress to restrict definitely the appropriation for this object, which was a misfortune for

which Major Powell is responsible, since the management of that department was of his own selection. The amount of work done in other departments of paleontology by the Survey is much less than it should have been. It is not necessary to call the attention of the present director of the Survey to the subject. An able paleontologist himself, he is not likely in his administration to neglect a department which is the life-blood of the science of geology. And, apart from its relations to geology, it has an especial importance of its own, which it is the business of a great government survey to foster.

In the later years of the Powellian period, the Survey made up for lost time in the quantity and quality of its stratigraphic work. It may be truthfully said that during the last five years no organization of the kind has turned out so large an amount of excellent original stratigraphic work at various and remote parts of the country. The habilitation of the Columbia, the Appomattox and Tuscaloosa formations of the Atlantic slope, and the correlation of the older paleozoic beds of the Appalachian Mountains must be credited to the geologists of the Survey. So also the definition of the epochs of the Cretaceous and Cenozoic beds of the coastal plain. The analysis of the strata of the Sierra Nevada has been immensely advanced, and much work has been done in the field of glacial geology. We look for a continuation of this work; and if some of the omissions of the past are supplied, the Survey will probably have the unanimous support of the scientific world.

—THE publication of the geological map of Pennsylvania by the State Survey marks an era in the history of that organization. Professor Lesley, the director, has issued an atlas containing the map of the State in four sheets, together with detailed maps of Bucks and Montgomery Counties, with maps of the bituminous coal areas of the western counties, with others. An atlas of county maps is issued at the same time. The geological maps are well colored, and are a credit to the State. The amount of the appropriation did not permit of the insertion of the topography by contour lines in either the State or County maps. This is to be regretted, but may be left for some future survey, which may issue a new edition. An important and obscure problem has been greatly elucidated by Dr. B. S. Lyman, the author of the Montgomery-Bucks map, i. e., the analysis of the red beds which are generally referred to the Trias. His division of the formation into several horizons will aid research, and we await the evidence of their paleontology to determine the relations of some of them. Another

problem of even greater significance awaits the labors of the Survey. This is the discrimination of the Cambrian and Ordovician beds of the eastern border of the mountains. The Calciferous and Trenton limestones both exist in this series, but they are still included in one formation by the present survey, as they were by the first survey, as No. II. Walcott has already made some progress in this direction, and it is certain that many important results will be obtained by further research.

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RECENT LITERATURE.

The genus Salpa.[1]—The Johns Hopkins Press has issued the second of the series of "Morphological Monographs," in the shape of a magnificent treatise on the genus Salpa by Professor W. K. Brooks. The monograph is an exhaustive one, without which no working library can afford to remain. It includes a brief but valuable survey of the anatomy of many species, a detailed account of the development of the solitary form from the egg, and of the chain Salpa from the stolon. The systematic position of Salpa with reference to other tunicates is discussed, and this leads the author to a wide biological consideration of the primitive pelagic fauna and the origin of the Metazoa. The evidence on the origin of the Chordata, to be gathered from the tunicates, is presented and is shown to be in opposition to the annelidian hypothesis of the derivation of this group. Dr. M. M. Metcalf contributes the final section, a careful study of the eyes and subreural gland of Salpa.

The chapter on the egg development of the solitary Salpa is especially interesting and suggestive. An outline of this remarkable development is as follows: The germ mass is present in the embryo of the solitary form, and extends into the stolon as the latter grows out. It is differentiated into a superficial epithelium and an inner mass of ovarian ova, which in the mature stolon form a single row. When the stolon is constricted to form the chain of salps, each Salpa body gets its particular portion of the elongated germ mass. In most species this consists of a single egg with its surrounding epithelium. The latter is differentiated into testes, follicle, and fertilizing duct, i. e. a tube attaching the egg to the dorsal wall of the chain salp, through which the spermatozoa pass to reach the egg—the egg itself lies in a blood sinus of the chain salp. It is evident from these facts that the alternation of generations in Salpa differs from the typical alternation of generations, in that the solitary form does not arise from the chain Salpa, but from an egg passed into the chain Salpa from the preceding generation of the solitary form.

As the embryo grows, it pushes out of the blood sinus in which it lies at first, into the cavity of the cloaca, driving the wall of the cloaca before it. From the dorsal wall a complicated system of covering

[1]The genus Salpa, by William K. Brooks. Baltimore, The Johns Hopkins Press, 1893.

embryonic membranes is formed. The inner end of the embryo remains exposed to the blood sinus of the chain salp, and from it the placenta is formed. The placenta of Salpa is fundamentally different from that of the Mammalia. It is merely a portion of the embryonic body through which the blood of the chain salp circulates. It appears to be exclusively a nutritive organ, not respiratory. The stream of water constantly passing through the cloaca of the chain salp and bathing the body of the embryo, makes a special respiratory organ unnecessary. The placenta performs its nutritive function in a way very different from that of the corresponding mammalian organ. In Salpa the placental blood current nourishes the placenta itself and causes the cells to multiply. The latter migrate into the body cavity of the embryo, where they degenerate and are used as food.

The very remarkable character of the egg development is due to the peculiar behavior of the follicle. During the segmentation of the egg, the follicle undergoes a considerable increase in size. Its cells proliferate and the follicle assumes a shape, which may be likened to that of a mature Graafian follicle of the vertebrate ovary. That is, there is a superficial (or somatic) layer of the follicle, connected over a small area with a central mass (visceral layer), the two elsewhere separated by a cavity. The blastomeres, which are forced apart by the growth of the follicular tissue, lie in the visceral layer and the region where visceral and somatic layers are connected. The follicle now proceeds to develop, as if it were going to form the embryo, while the blastomeres remain few in number, scattered about in the midst of the mass of follicular tissue. It is impossible without figures to explain the way in which the follicular tissue is folded and hollowed out, to form the various parts of what appears to be the embryo. It may be said in a word that the follicular tissue gives rise to a body, which is a "simulacrum of the embryo." In this body, pharynx, cloaca, gill and gill-slits, are all developed, but are lined with the follicular cells of which the great mass of the body is composed. As the various organs are outlined in the follicular tissue, the blastomeres take up certain more or less definite positions with reference to each organ. Finally the blastomeres begin a rapid growth, and in each organ and throughout the body they take the place of the follicle cells, the latter degenerating and being ultimately used up as food. Thus in fact the Salpa embryo, like that of other animals, is derived from the egg cell and not from the follicle, as some investigators have held.

Professor Brooks suggests an explanation, which is probably the true one, of the behavior of the follicle in the Salpa embryo. It is well known that in many tunicates the follicle cells migrate in between

the blastomeres, more or less completely surrounding the latter, in which position they are finally used up as food. And the peculiar behavior of the follicle in Salpa is probably to be explained on the theory that Salpa has had an ancestor in which the follicular tissue persisted late in the development, and was so accurately disposed around and between the organs as to form what might be called a cast of the embryo.

In the modern Salpa, as in the hypothetical ancestor, the follicular tissue develops into a cast of the embryo, but the blastomeres instead of leading the way as they doubtless did in the ancestral embryology, are now so retarded in their development that they do not begin to build up the embryonic organs until the follicular cast is well nigh completed. H. V. WILSON.

Bateson's Dictionary of Variaton.[1]—In this work the author has collected a great many examples of variations from normal structures found in animals. These include both absolute abnormalities and variations which are in the line of evolution. The work is a useful one to all zoologists aud students of evolution, as furnishing examples of variation in groups with which they are not personally familiar. It will, however, not take the place with any specialist of his knowledge of the subject matter of his own studies. It is not to be supposed that its author intended that it should. A dictionary of variation of all animals would be a detailed work on zoology in general, where the normal characters of all species should be stated, in order that it might be shown what constitutes variation. Such a work could only be produced by the cooperation of a large number of "species naturalists." Embryologists and histologists would be wholly unfit for the task. Perhaps it was a sense of this deficiency which led Mr. Bateson to prepare this work; for otherwise it is difficult to imagine why an expert in any branch of zoological sciences should attempt the task, unless it should be designed for amateurs and general readers. While preparing the work, its author neglected one of the richest mines of information as to normal variation. This is found in the writings of American specialists in vertebrate zoology, where the subject has been treated in greater detail, and with greater wealth of material than exists in the literature of any other country. The book is well illustrated, which greatly enhances its value. We recommend it for study to persons who are doubtful in their opinions on the subject of organic evolution.

[1]Materials for the Study of Variation treated with especial Regard to Discontinuity in the Origin of Species. MacMillan & Co., London, 1894, pp. 598.

General Notes.

GEOGRAPHY AND TRAVELS.

Antarctic Exploration.—The most important geographical discoveries made in the Antarctic regions since Ross traced a part of Victoria Land's coast, and saw its smoking mountains, fifty-two years ago, have just been reported by an old and well-known Norwegian whaler, Captain Larsen, who, by this time, is undoubtedly on his way home with a cargo of seals. His discoveries were made in the latter part of November and early in December last, on the steam whaler Jason. Later he went north to the Falkland Islands, where he found an opportunity to send home his log for this period. He then returned to the sealing grounds near the Antarctic Circle. His log was forwarded from Norway by Mr. Christensen of Sandefjord to Dr. John Murray, the well-known Scottish scientist and member of the Challenger expedition, who has just published the extract from the Jason's journal in the *Scottish Geographical Magazine.* Only a few lines, including the latitude and longitude attained, are given in the log to each day's events, and the narrative is therefore lacking in detail. When Capt. Larsen returns to Europe, he will doubtless give a full account of his interesting voyage.

If the reader will refer to a map of the Antarctic regions, he will see a large land mass, known as Graham's Land, lying across the Antarctic Circle, south of Cape Horn. Except Victoria Land, which lies on the other side of the Antarctic area, Graham's land is the largest bit of *terra firma* that has yet been found in South Polar waters. It was discovered by John Biscoe in 1831, and a brief allusion to the exploration there is necessary in order to understand what Larsen has achieved. Biscoe skirted its lofty western coast for about 200 miles, and, landing on little Adelaide Island, not far from the mainland, he was the first to set foot on shore within the Antarctic Circle. No one ever saw any other part of Graham's Land except Ross, over fifty years ago, and the Scottish and Norwegian whalers who were there in the season of 1892-93. Capt. Larsen's recent achievement was to steam for days along the east coast of the unknown land, and when he was finally compelled to turn north again, he could still see the lofty summit of the mainland stretching south and east as far as the eye could reach. Dr. John Murray

and other authorities believe that in those days he was skirting a part of the coast of the great Antarctic continent, and while he was adding to our knowledge of the coast lines around the South Pole, he also discovered some volcanoes in a highly active state, showing that Plutonic energy in that part of the world has not yet died out, and that its activity there is more widely distributed than we had any reason to suppose.

The ice conditions greatly favored Capt. Larsen, for he found a comparatively open sea, and was able to advance about one hundred miles south of the Antarctic Circle. Only the year before the whalers had found the sea packed with ice almost to the extreme northern part of Graham's Land. As they looked south they saw a chain of bergs towering high above their ships, which effectually barred their progress in that direction. After Ross, in his sailing ships Erebus and Terror, had discovered Victoria Land and skirted its coast for hundreds of miles, he spent almost the entire season of 1842-43 near the north end of Graham's Land trying in vain to push his way through the ice-encumbered sea and the great chain of bergs. He was not able, however, to advance toward the south until he went far east, out of sight of Graham's Land, whose mystery he had hoped to solve. Larsen had a very different experience in November and December last. The weather was fine and warm, and there was plenty of sunshine and little fog. The air and sea teemed with animal life, for many birds, whales and seals were seen, and, best of all, the white, east coast of Graham's Land, rising here and there into lofty peaks, stood out clearly in view. He followed it straight to the south, until, at its furthest point, he saw it rising to still loftier heights and stretching away to the southeast and east.

From Capt. Larsen's log, and from the observations of the whalers at the north end of Graham's Land, in the previous season, we are able to get some idea of this *terra incognita.* According to his log, Capt. Larsen steamed along this east coast for 230 miles, the coast line stretching away a little east of south, a high, rocky shore, most of it a few miles west of 60° west longitude from Greenwich. Right at the Antarctic Circle is a very high peak, most of which is bare of snow. The shore front is skirted with an ice barrier that runs about five miles out to sea, and is from twenty-five to sixty feet high. The land is covered with an ice cap and glaciers flow down the valleys, but in the narrow, northern part of the land they are, of course, small, and do not produce icebergs over sixty to seventy feet in height. In 1892-93 the whalers saw in the neighboring waters bergs that were 200 feet or more

in height, and their depth below the surface must have been at least 1,400 feet. It is certain that they come from some more southern part of the Antarctic region.

Skirting the shores, Larsen saw numbers of islands and rocks, all volcanic and mostly basaltic, rising out of the sea almost as perpendicular as the icebergs, and presenting little surface on which snow can rest. He succeeded, however, in landing on Seymour Island, and pushed some distance into it, though the walk was most difficult across the deep valleys and over the high rocks. Great numbers of penguins had their nests there, and in the interior he found several dead seals. These penguins are peculiar to the Antarctic regions, and their rookeries are very curious. They are occupied by countless numbers of the common black-throated penguins, and the nests are crowded together in square blocks formed by paths intersecting one another almost at right angles. The whalers of the previous year said that these rookeries, viewed through a telescope from the ship's head, had the appearance of hair brushes, the penguins representing the bristles.

It was about eighty miles north of the Antarctic Circle that Larsen discovered a chain of five little islands, extending in a straight line from northwest to southeast. The most northern is about ten miles from the mainland. Two of these islands are active volcanoes. The captain and his mate fastened on their snow-shoes and crossed on the ice to one of the islands. A large volume of smoke poured from both of the volcanoes, but neither of them was ejecting lava or solid matter at the time, though the ice in the neighborhood was strewn with volcanic stones that had recently been hurled out of the craters. There was no snow on these volcanic masses.

On his journey south, Capt. Larsen saw many whales and seals. It is well-known that the Dundee whalers turned their attention to the Antarctic regions in 1892, in the hope of finding the true whalebone whale, which Sir James Ross believed he saw there. The Dundee fleet, however, saw neither this variety nor any sperm whale. They saw any number of finners, which were so tame that the ships actually struck them sometimes before they would get out of the way. Now and then these enormous creatures, not less then eighty feet in length, jump like a salmon, every portion of their bodies being clear of the water. The hunchback whale, which was found there in great numbers, is another interesting species. The whalers say that neither salmon nor trout fishing can equal the hunchback for sport. Larsen hunted one which, on being harpooned, ran the five lines in the first boat straight out and got free. Four additional harpoons and six rockets

were fired into it. It fought a thirteen hours' battle and then escaped, taking with it a good deal of line, two of the harpoons, and all of the rockets. Larsen saw three other species of whales there, but none of much commercial value, while the seals are desirable chiefly for their oil.

The most southern point reached by Capt. Larsen was in 68° 10 south latitude. Had he advanced a few miles further, it would have been necessary to turn quite abruptly to the east, for he saw the shore line bend around till it ran almost due east and west, and behind it was high land covered with snow. He had followed the coast on the east side of Graham's Land as far as Biscoe had traced it on the west. On the map the reader will find Alexander I. Land, which is due west of the high land seen by Larsen when he turned his ship to go north again. Dr. Murray believes that Alexander I. Land is a part of the west coast of Graham's Land, and that this landmass, which Biscoe and Larsen proved to widen rapidly toward the south, is only a peninsula of the continent of Antarctica.

It is interesting to consider the geographical significance of Larsen's voyage. Our maps show that all around the Antarctic area, in the neighborhood of the South Polar circle, bits of land have been discovered. It is noteworthy that scarcely one of these bits of land has been explored in its whole extent. The explorers did not ascertain whether the land they saw was islands or projections from some great landmass. Discoverers have very rarely been able to effect a landing on account of the belt of pack ice or ice floes, often ten to twenty miles wide, that separated them from the shore. There are several excellent reasons why many of the leading geographers and geologists believe that these various lands—Victoria, Graham, Wilkes, Adelie, Clarie, Sabrina and Termination Lands and some others, are merely parts of the outer edge of a large continent. To mention here only one of these evidences, the Challenger expedition, sounding in Antarctic waters, brought to light material which is regarded as strongly indicating the proximity of a landmass of continental proportions. Ross believed this when he was in the region where Larsen has made his reconnoissance. Ross said that though the ice prevented him from taking his vessel south, he believed he could have landed and travelled over the continent. Larsen's work adds strength to the theory, for we see Graham's Land rapidly widening as its coasts are followed toward Victoria Land. A great deal of the area within the Antarctic Circle may be covered with the sea and still leave room there for a land of continental extent. It has been observed, when possible to approach the land, that there is much

similarity in the geological structure of the apparently detached masses. Dr. Wild, of the Challenger expedition, has observed that Graham's Land and Victoria Land are remarkable for the height of their mountain ranges, rising from the sea to 7,000 feet in the former, and 15,000 feet in the latter country, and the shores of both are guarded by numerous islands, mostly of volcanic origin. Wild, Murray, and others say that we are justified in concluding that Victoria Land, whose east coast line was traced by Sir James Ross for more than 500 miles, must extend much further to the west and south, and that probably on its ice cap will be found the present position of the South Magnetic Pole.

Dr. Murray points out that the summer excursion of Larsen's little whaler, shows what large additions might, in a short time, be made in our geographical knowledge by a properly equipped expedition provided with steam power. British geographers will be more than ever encouraged, now that the news of Larsen's work has come to them, to redouble their present efforts to induce their Government to send out an expedition. The expenditure will hardly be justified unless the proposed expedition is accompanied by scientific men and fitted with all the apparatus of scientific investigation. Such a party and equipment would enrich almost every department of natural science. There is no doubt that the science of our day is demanding such an investigation, and, in all probability, it will be carried out within the next few years. Not only scientific men, but also a considerable part of the public, would like to know the nature and extent of this Antarctic continent and what may be learned by pushing into its interior. It is highly desirable, also, as the advocates of South Polar exploration have shown, to ascertain the depth and condition of the ice cap, to sound the ocean depths, to learn its various temperatures, from the surface to the bottom, to trawl up the animals on the sea floor, and study the nature of the marine deposits. These are among the questions that explorers will be called upon to solve in the prolific field of South Polar research.—CYRUS C. ADAMS, in *New York Sun.*

MINERALOGY.[1]

Friedel's Cours de Mineralogie.[2]—The first part of a text-book of mineralogy by Charles Friedel covers the field of general mineralogy. In the preface it is stated that a second part, devoted to special or descriptive mineralogy, will be prepared with the assistance of M. George Friedel, the author's son. The book does not claim to be, the author states, a treatise on crystallography or crystal physics, but a practical method of determining minerals on the basis of their morphological, physical, and chemical properties. It is intended for the use of those students who are preparing for the examinations for licentiate in physical sciences, and should therefore be adapted to the needs of college students.

The book contains 416 pages with the subject matter distributed as follows: introduction (giving history of science and fundamental definitions, 16 pages); organoleptic properties, 16 pages; crystallography, 238 pages; physical (and optical) properties, 59 pages; chemical composition occupies the remainder of the book and includes the divisions, blowpipe methods, mineral synthesis, and mineral classification. Under organoleptic properties are included among others, structure, color, lustre, density, external form (with a consideration of pseudomorphs), hardness, and streak. In treating crystallography eight pages are devoted to an exposition of Hauy's *théorie des décroissements.* This is followed by sections on the law of rational indices and symmetry. After deriving the crystal systems, the author gives eight pages to an exposition of Bravais's theory of crystal structure. No mention is made of the work of later writers on this subject, and throughout the book a tendency to utilize mainly the work of French writers seems manifest. The difficulties of translating Levy's symbols into those of Weiss, Naumann, Dana and Miller, makes it necessary to devote thirty-seven pages to crystallographic notation. Twelve of these are consumed by a table giving the equivalents of Levy's symbols in the other notations. An usually large amount of space for a book of this sort is devoted to the representation of crytals, but those which illustrate the book are very poor. Many of the figures are not merely carelessly, but incorrectly drawn. Crystals having a principal

[1]Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2]Cours de minéralogie professé a la faculté des sciences de Paris, par Charles Friedel. Minéralogie générale, pp. iii and 416. Paris, 1893.

axis are generally lopsided. Figures 70, 138, 224, 255 and 322 are a few of the incorrectly drawn crystals. Another bad feature of the illustrations is that crystals are not always properly set up but are seen from all directions. The best portions of the work are those which treat optical mineralogy and mineral synthesis. The former is treated without mathematics and in a simple and practical manner. The section on the classification of minerals is very unsatisfactory. What purports to be a history of the subject is given. The systems mentioned are those of Werner, Hauy, Beudant, Delafosse and Dana. Groth's system is not mentioned nor is that of any other modern German mineralogist. A considerable number of pages is devoted to detailed lists of minerals as they appear in the schemes of Werner, Delafosse, and Dana. With the exception of the latter, which Friedel adopts as the one most in harmony with the present state of the science, these lists seem out of place. The book is not provided with an index, but has a somewhat extended table of contents.

As a text-book the work is subject to criticism on account of its classification and arrangement of subject matter, its lack of perspective in the treatment of the different divisions of the subject, its tendency to utilize mainly French investigations and systems, and its faulty illustrations.

Relation between Atomic Weight and Crystal Angles.—In a paper entitled, "Connection between the Atomic Weight of contained metals and the magnitude of the angles of crytals of isomorphous series, a study of the potassium, rubidium and cæsium salts of the monoclinic series of double sulphates $R_2M\ (SO_4)_2\ 6\ H_2O$," Tutton[3] has given the results of a most careful and thorough crystallographical study of an isomorphous series of salts, to determine the kind and degree of effect which the different bases exert upon the crystal angles. The results are very interesting since they seem to show a relation between the atomic weights of the contained bases and the crystal angles. The work involved no less than 9,500 measurements. The crystals were obtained by slow crystallization from cold solutions and ten good crystals of each salt were selected for measurement from a dozen or more different crops. The double salts of the formula $R_2M\ (SO_4)_2\ 6\ H_2O$ containing as univalent metals either potassium, rubidium, or cæsium, and as bivalent metals either magnesium, zinc, iron, manganese, nickel, cobalt, copper, or cadmium, were always pre-

[3]Jour. Chem. Soc. London, Trans., Vol. LXIII, (1893), pp. 337–423.

pared by mixing solutions of the two simple sulphates in equal molecular proportions. The study shows that the bivalent metal exerts no appreciable effect on the crystals, the predominant effect being due to the univalent metal present. The crystals of the potassium, rubidium, and cæsium salts have each a peculiar habit, that of the rubidium being intermediate between the other two. The axial angle β increases from the cæsium, through the rubidium to the potassium salt, its value in the rubidium salt being midway between the values in the cæsium and potassium salts. This is in close correspondence with the differences between the atomic weights of those bases. Tutton says "The relative amounts of change brought about in the magnitude of the axial angle by replacing the alkali metal potassium by rubidium and the rubidium subsequently by cæsium, are approximately in direct simple proportion to the relative differences between the atomic weights of the metals interchanged." The other crystal angles of the rubidium salts are likewise intermediate in value between those of the potassium and cæsium salts, but they do not show the same relation to the atomic weights of the alkali bases, the maximum deviation from such a relation being found in the prism zone. As these angles are for rubidium nearer to those of potassium than to those of cæsium, the author thinks that as the atomic weight of the alkali metal introduced gets higher, the effect of the metal on certain angles increases beyond a mere numerical proportion. Professor Tutton announces that this communication will be followed by another, which will discuss the changes in the optical constants of the crystals due to the same chemical substitutions.

Spangolite from Cornwall.—Miers[4] has found in a collection of Cornwall minerals presented to the British Museum, small crystals of the new mineral spangolite described by Penfield in 1890. The Cornwall crystals show the hexagonal prism, pyramid, and base. Their association is remarkably like that of Penfield's spangolite, as they occur with cuprite and its alteration products. From the characters of the associated liroconite and clinoclase, Miers thinks that there can be no doubt that the specimen is from St. Day, near Redruth.

Eudialite from the Kola Peninsula.—The occurrence of eudialite in the nephelene syenite and pegmatite of the Lujawr-Urt and Umptek in Russian Lapland, recently mentioned by Ramsay, has now been studied in detail.[5] The crystals have developed on them the

[4]Neues Jahrbuch, 1893, II, 174.
[5]Neues Jahrbuch, Beil. Bd., VIII, (1893) 722.

forms R, $-\frac{1}{2}$R, $\frac{1}{4}$R, —2R, ∞ R2, ∞R, and oR. The axial ratio is a:c =1:2.1072. The mineral has good cleavage parallel to the base and one varying from very good to poor runs parallel to the second order prism. The color is usually cherry to garnet red. The crystals are specially interesting because of a marked zonal structure and of a division into sectors having differences in double refraction. Some of these sectors have positive and others negative double refraction. Like the eudialite from Magnet Cove the crystals are optically anomalous, sometimes having biaxial character with optical angle as large as 15°. On heating the sections of the crystals to a temperature at which boracite had become isotropic, all the sectors of the field seemed to give negative double refraction. Ramsay finds evidence that the different zones of the mineral possess different specific gravities as well as different double refraction, and he considers this to be due to isomorphous growth together of eudialite and eucolite. He shows that as regards axial ratio, specific gravity, double refraction and optical character, there is a gradation from the eucolite of Arö through the eudialites of Umptek and Kangerdluarsuk to the eudialite of Magnet Cove.

PETROGRAPY.[1]

The Ejected Blocks of Monte Somma.—Johnston Lavis[2] has begun a thorough study of the ejected blocks of Monte Somma, with especial reference to their petrography and the nature of the metamorphic changes that have been produced in them by the lavas by which they were enclosed. The druse minerals of the blocks have long been known, but their nature as rocks has been left uninvestigated. The author proposes to study in detail about 700 specimens of the blocks, including many varieties. He begins by describing some 30 that were originally stratified Cretaceous limestones containing carbonaceous material. The first stage in their alteration seems to be the conversion of bituminous substance into graphite, and the crystallization of the rock into marble. The crystallization has not destroyed the original bedding bands, nor the most delicate structures exhibited by them, hence it is assumed that fusion or softening of the rock did not accompany the crystallization processes. A few olivines were formed• at this tisme, and these consequently are the first products of the metamorphosing agency. They appear principally as inclusions in the calcite. In the next stage of alteration the graphite disappears, and a saccharoidal marble results. This contains more or less colorless olivine, and passes rapidly into a mass of olivine, colorless pyroxene, wollastonite and biotite, where impurities were present in the original rock. In the earlier stages of metamorphism the calcite and the silicate minerals will exist in different bands, but in later stages silicates and calcite intermingle, and finally a purely silicate rock results. The order in which new minerals seem to develope is thought to be the following; olivine, periclase, humite, spinel, mica, fluorite, galena, pyrite, wollastonite, garnet, vesuvianite, nepheline, sodalite, feldspar, secondary calcite, tremolite, brucite. The article is illustrated by three lithographic plates. It will repay close study by students of contact action, as we have recorded in the blocks the effects of the action of a magma upon a limestone, in all its stages.

Phonolites from the Black Hills.—The sanidine-trachyte described by Caswell[3] from Bear Lodge in the Black Hills, has been

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2]Tarns. Edin. Geol. Soc., VI, 1893, p. 314.
[3]U. S. Geog. & Geol. Survey of Rocky Mts. 1880. Cap. VII, p. 471.

reexamined by Pirsson,[4] who finds it to be a phonolite with phenocrysts of anorthoclase and pyroxene, in a groundmass of the usual components of phonolite. The anorthoclase has the composition:

SiO_2	Al_2O_3	Fe_2O_3	CaO	Na_2O	K_2O	H_2O	Total	Sp. Gr.
66.44	19.12	.56	tr	7.91	5.10	.57	= 99.70	2.585

The nepheline is all in the groundmass where it appears as idiomorphic crystals. The density of the rock is 2.582 and its composition:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	BaO	MgO	Na_2O	K_2O	H_2O	Cl	SO_3	Total	Cl	
61.08	.18	18.71	1.91	.63	tr	1.58	.05	.08	8.68	4.63	2.21	.12	tr	= 99.86	—.03	= 99.83

A second occurrence of phonolite within the same region is in a dyke just south of Deadwood. It consists of phenocrysts of reddish feldspars and black hornblendes that approach barkevikite in properties. The rock from the Black Hills sold by the dealers as tinguaite is a dense aggregate of pyroxene phenocrysts in a matrix of feldspar and aegirine, with an occasional patch of nepheline.

The Origin of Norwegian Iron Ores.—The iron and other ores of many of the Norwegian localities are connected genetically with granites and gabbroitic eruptives. The iron ores in veins are supposed by Vogt[5] to be due to contact action between granite and the surrounding rocks. Those connected with the gabbros are basic accumulations, whose origin is ascribed to differentiation of the basic magma. In consequence of this differentiation, which is governed largely by Soret's principle and the differences in density of the various differentiated products, the gabbro splits into labrador-rock and various iron-olivine and iron-pyroxene compounds, and in these latter are accumulations of magnetite and ilmenite large enough to constitute ore bodies. Each of the iron-pyroxene rocks is described by the author and the iron ores associated with them are characterized. The titanium of the iron is thought to have originated mainly in the olivine and other basic components of the normal gabbro.

The Tonalites of the Rieseferner.—The tonalites of the Rieseferner in the Tyrol are again the subject of careful petrographical study.[6] The normal tonalite (hornblende–mica–quartz–diorite)

[4]Amer. Jour. Sci., XLVII, 1894, p. 341.
[5]Geol. Fören Stock. Förh. 13 and 14.
[6]Becke: Min. u. Petrog. Mitth., XIII, p. 379.

which is a coarse granular rock, on its periphery often becomes finer grained and porphyritic. Large biotites and hornblendes are scattered through its groundmass, which remains fine grained, and the rock thus takes on a prophyritic habit. At other times the decrease in the size of its constituent grains is accompanied by a decrease in the proportion of plagioclase and quartz present in the rock and a large increase in the orthoclase present, while hornblende disappears completely. It is unnecessary to give the petrographical details of the author's paper. It should be mentioned, however, that the feldspars are very carefully studied by comparing the differences in their refracting indices, and many new points are brought out concerning their relations to each other. Some of the plagioclases were found to consist of nuclei of basic plagioclase, enclosing areas of a more acid feldspar identical with an acid peripheral zone. The phenomenon is thought to be due to corrosive influences. In addition to the various phases of the tonalite mentioned, the author makes a careful study of the veins cutting them, and of the slight alterations they have suffered and he refers to the existence of gneiss fragments occasionlly met with in their peripheral portions.

Petrographical News.—McMahon[7] cites, as evidence in favor of the eruptive character of the Dartmoor granite, and in opposition to the view of Ussher that it resulted from the fusion by pressure of preexisting pre-Devonian sedimentaries, the following facts. Its apophyses cut the surrounding rocks. The metamorphic changes effected in the latter are the result of contact action. Finally the other rocks with which the granite is associated show no evidence of the great pressure, to which they must have been subjected if the granite were truly a fused sedimentary.

Associated with the argillites, graywackes and other sedimentary rocks of the Keewatin series near Kekaquabic Lake in Northeastern Minnesota, Grant[8] has discovered volcanic fragmentals and amphibole schists, the former of which are recognized as diabase tuffs and the latter as their recrystallized representatives.

A quartz bearing leukophyre variety of diabase porphyrite, forms intrusive layers in the Carboniferous schists at the Hernitz Mine near Saarbrücken in the Pfalz.[9] The rock was regarded by Weiss as a melaphyre.

[7]Quart. Journ. Geol. Soc., XLIX, p. 385.
Proc. Somerset Arch. & Nat. Hist. Soc., Vol. 28, p. 892.

[8]Science, XXIII, 1894, p. 17.

[9]Laspeyres: Corr. Blatt. Naturh. Ver. Bonn., 1893, p. 47.

The tuffs found with the nepheline leucite basalts of the Dauner region in the Eifel are made up of augite, mica, and olivine fragments, augite crystals, glass particles and lapilli cemented together by quartz and felspar which represent an original glassy cement.[10]

On the west coast of the Island of Celebes, Wichmann[11] finds boulders of an epidote glaucophane-mica schist, supposed to be associated somewhere in the interior of the island with mica quartzite.

[10]L. Schulte: Verh. d. Naturh. Ver. Bonn., 1893, p. 295.

[11]Neues Jahrb. f. Min. etc., 1893, II, p. 176.

BOTANY.[1]

Abnormal Plant Growths.—*Trillium grandiflorum* Salisb., is noted for its variableness, but a specimen brought in by one of our pupils, this spring, exceeds anything I have seen in this respect. The flower is double, having two sets of sepals, and two of petals. Both sets of sepals are of the usual form and color. The outer petals are striped like ribbon-grass, except the half of one which is white. The inner ones are white, except a thread of green through the center of one. There are three stamens—one normal, one a filament without an anther, and the other expanded into a half-sized petal, concave on one side where a thread of gold, about the length of the anther, seems to be holding loyally to duty. The ovary is of usual size, the styles rather small—one smaller than the others. Near the top of one of the carpels arises an outgrowth about half an inch long, white, doubled together, and drawn over at the top like a hood. To add to the general confusion, there are, on the edges of this growth near the top, two pollen-bearing lines about an eighth of an inch long.

A member of my botany class, Mr. Cheshire Boone, found a specimen of *Hepatica acutiloba* DC., with two flowers on one scape. The second flower arises from the axil of a linear bract a little above the middle of the scape. It is on a peduncle an inch long, and is about half the size of the upper flower.

Another unusual form found this spring is *Viola palmata* L., var *cucullata* Gray, with all of the petals emarginate.

State Normal School, LUCY A. OSBAND.
Ypsilanti, Mich., May, 1894.

The Approaching Meeting of the A. A. A. S.—The meeting of the American Association for the Advancement of Science, this year, from August 15th to 24th, promises to be of great interest to botanists. It is to be held in Brooklyn, N. Y., within a few hours' ride of the homes and laboratories of probably one-half of the working botanists of the country, which may be counted upon as insuring a large meeting. Added to this is the fact that at this time will occur the first meeting of the American Botanical Society, which must attract many of our most earnest workers.

[1]Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska,

The Completion of Coulter's Texan Flora.—Within a few weeks, botanists have received copies of Part III of Dr. John M. Coulter's "Manual of the Phanerogams and Pteridophytes of Western Texas," published by the Department of Agriculture, as one of the Contributions from the U. S. National Museum. A glance over its pages shows it to be an important contribution to North American botany, covering, as it does, a region whose botany has hitherto been scattered through many different reports and papers. That the work is well-done, need not be said of anything from the masterhand of Dr. Coulter, who has here again shown his ability to make a much needed book. This volume carries southward the area covered by Coulter's "Rocky Mountain Botany," and gives to the author a kind of "preemption right" to a belt of botanical territory stretching from the Canadian line on the north (N. Dakota, Montana and Idaho) to the Mexican boundary on the south (Texas and New Mexico). It will clearly be his duty to enlarge his "Rocky Mountain Botany," so as to take in the territory of this Texan Flora; then by adding the Arizona-Nevada region, make it cover the whole of the Western Highlands, from about the 100th meridian to, but not including, the Pacific Coast Region. Such a "Botany of the Western Highlands" would, on many accounts, be much more likely to be successful than the two or three manuals which it now seems probable we are to have for this region.—Charles E. Bessey.

ZOOLOGY.

An Australasian Sub-family of Fresh-water Atherinoid Fishes.—Mr. J. Douglas Ogilby, of the Australian Museum, of Sydney, has recently sent me a photograph and description of a new species of a genus called *Aristeus* by Castelnau. This genus is of much interest from a morphological as well as geographical point of view. Mr. Ogilby has asked, "Is it an Atherinid and allied to *Nematocentris?* or should a new family be formed of it?" Mr. Ogilby, unlike the original describer, is quite happy in his appreciation of its affinities.

The genus *Melanotœnia* was proposed by Gill in 1862 (Proc. Acad. Nat. Sci. Phila. 1862, p. 280) for a fish called *Atherina nigrans* by Richardson, and was subsequently renamed *Nematocentris* (Peters, 1866), *Strabo* (Kner & Steind, 1866), and *Zantecla* (Cast., 1873). It has been generally referred to the *Atherinidœ*, but Kner and Steindachner were disposed to associate it with *Pseudomugil* in their family *Pseudomugilidœ*, and Castelnau proposed a new family, *Zanteclidœ*, for it. No satisfactory family characters were given.

The genus *Aristeus* was described by Castlenau in 1879, and by him referred to the family *Gobiidœ*. Steindachner, in a notice of the genus (Zool. Jahresber. 1879, p. 1061), happily hit at its relations in the words, "*Aristeus* N. G. Casteln. (wahrscheinlich.=Nematocentris, d. Ref.)."

There are two specially interesting features of these genera.

(1) They deviate from the typical Atherinids in the elongated anal fin which advances far forward, and with the advance are coordinated an advanced position of the anus and of the ventral fins, whose roots are little behind the bases of the pectoral fins.

(2) The species of both genera are confined to the fresh-waters of the Australasian realm and the constituent group is thus one more of the groups limited to a single realm.

The deviations of the genera from the typical *Atherinidœ* appear to be sufficient to warrant their segregation in a peculiar sub-family which may be named *Melanotœniinœ.* But confirmation by anatomical characters are very desirable. The sub-family may be defined provisionally, as follows:

MELANOTÆNIINÆ. Atherinids with a spinous dorsal, whose foremost spine is robust and rest weak, a very long anal, and thoracic

ventral fins. Inhabitants of the fresh waters in the Austrogean (Australasian) realm.

The genera may be differentiated as follows:

MELANOTÆNIA. Melanotæniines with a little compressed fusiform body, slightly curved dorso-rostral contour, and a blackish lateral band.

RHOMBATRACTUS. Melanotæniines with a much compressed rhombo-fusiform ventradiform body, emarginate dorso-rostral contour, and no distinct lateral band.

Aristeus having been used in 1840 by Duvernoy for a genus of Crustaceans, is unavailable for the group so-called by Castelnau, and *Rhombatractus* is used as a substitute.

Rhombatractus has a curious superficial resemblance to a toxotid on account of its compressed body, declining back and ventradiform contour, but the head is that of an atherinid.

It may be that the Melanotæniines should be accorded family rank, but further data are desirable before such a claim is recognized. One of the subordinal characters of the Percesoces, in any case, must be modified to fit these fishes.—THEODORE GILL.

EMBRYOLOGY.[1]

Earthworm Phylogeny.—The great accumulations of anatomical facts that the study of exotic earthworms has brought into existence during the past few years is now to be made more intelligible by the added facts of comparative embryology. It is a fitting tribute to one who has inspired so much of this recent exploration into this field that Bourne's paper[2] upon the development and anatomy of certain Indian earthworms should appear in the complimentary number of Lankester's Quarterly Journal.

When the study of exotic earthworms had shown that there might be large numbers of micro-nephridia, present in any segment and when it was even claimed that tubules of these micro-nephridia might anastomose to form a connection from segment to segment, the view of Lankester became less tenable as it became more probable that the ancestral condition of the earthworm was not what the common European earthworm had led one to expect.

It seemed probable that the ancestor of the earthworm might have had a large number of nephridia and of setæ and no definite segmental arrangement of these structures.

Now, however, we learn from Bourne's paper that in the development of *Mahbenus imperatrix* and *Perichæta* the vexatious micro-nephridia arise as out-growths from provisional mega-nephridia and are thus of apparent secondary value. The ancestral condition of a pair of nephridia for each segment being clearly indicated even in these cases. The connection of nephridial tubes, the so-called "plecto-nephric" condition does not, apparently, exist at all, certainly not in the embryo.

We learn also that in these exotic forms, such as Perichæta (which is common with us in green-houses) the large number of setæ found in a band around each segment are not to be regarded as of ancestral value since they all arise from two germ bands that then give rise to matrices which grow laterally in each segment and form the numerous setal sacs by segregation of cells and by division of matrices. The setal germ bands in turn are regarded as probably arising from Wilson's lateral teloblastes.

Besides thus throwing much light upon the probable ancestral con-

[1] Edited by E. A. Andrews, Baliimore, Md., to whom contributions may be sent.

[2] A. G. Bourne. Q. T. Mic. Anat., April, 1894.

dition of seta of nephridia in the earthworm group the author's more detailed future work promises to add to our knowledge of other difficult points, such as the origin of the nerve cord, which it is here stated arises from two distinct matrices.

Bourne is inclined to regard the germ bands as the source of all the metameric structures. The body wall muscles would be of other origin. The segmentation of the digestive tract a secondary state forced upon it by the mesoblastic structures.

Determination of Sex.—What at first sight appears to be an interesting and valuable addition to the facts tending to show that favorable conditions lead to the production of female offspring and unfavorable conditions to the production of male offspring is to be found in a paper by F. Braem[3] upon the development of a marine polychætous annelid, *Ophryotrocha puerilis.* Here, however, as in some other cases, the evidence is really of little value as may be seen from the facts given by Korschelt in a paper immediately following that of Braem.

Braem found in attempting some regeneration experiments in addition to his study of the ovaries and testes that in one case there was a remarkable change of sex. A female annelid full of ripe eggs was cut into two pieces, the anterior containing 13 and the posterior 22 segments. After three weeks the anterior part had regenerated seven segments.

It had become smaller and appeared to be starving while the eggs had disappeared. When sectioned it was found to have changed its sex, containing only testes. A few cells remained that were ova in process of formation before the sexual glands changed their character and began to form sperms.

The author would refer this transformation into a male to the unfavorable conditions, to the fact that the creature was not sufficiently nourished to form ova as well as to regenerate the lost part of its body.

Now Korschelt in a careful study of the anatomy of this same small annelid finds that besides males and females, there are also hermaphrodites (in fact Braem found one such case) in which the same gland makes both ova and sperms. Among 30 individuals 6 were female, 7 were male, 8 were apparently female but contained male cells both young and full formed, white the remaining 9 were apparently male though containing ova in the testes. Thus the hermaphrodite state is the more frequent one, to judge from these few cases.

[3] Zeit. f. wiss. Zool., 57.

Though there is no evidence that the male and female states may normally succeed one another in the same animal, yet when this, apparently, was the case in one specimen operated upon by Braem, we are not justified in regarding this is as a result of the operation or as in any way connected with it, since it may be that it would have taken place under the normal conditions. Moreover, and this is more important, the animal full of eggs may very well have been a hermaphrodite from the first, and have merely re-absorbed its ova under the stress of regeneration, so that we know nothing as to any real change from female to male in this case.

PSYCHOLOGY.

Mutualists.—Many animals which are found associated with other animals and which are usually termed parasites are, in fact, true mutualists. I mean by the term, mutualist, an animal which gives a *quid pro quo* or specific beneficial service to the host which affords it sustenance and domicile. A true parasite feeds on the food or the physical juices and structures of its host without rendering any reciprocal service whatever. Thus, the family *Pediculidæ* (*P. corporis, P. capitis, etc.*), found associated with man, are true parasites, while the family *Riciniæ*, found associated with birds, are true mutualists. I am fully aware of the fact that I antagonize the opinions of entomologists (who regard all these little creatures as parasites which are to be destroyed as soon as discovered, inasmuch as they consider them detrimental to the health of the animals upon which they are found), for I consider most of them absolutely necessary to the health and well-being of their hosts, and their absence to be an indication of disease in some form or other in those animals on whose bodies they are not to be found. Careful observation has taught me that these faithful little hygeinic servitors immediately abandon the bodies of fowls which are the victims of cholera and kindred diseases. Porcine mutualists behave in a like manner when their hosts become diseased. I had thought with others until recently, that these corporal scavengers and toilette assistants were parasites, but systematic and painstaking observation has taught me otherwise. In the first place, microscopic examination shows that these creatures have no suction apparatus like fleas (*Pulex*) and lice (*Pediculus*) for the purpose of sucking up the blood and juices of their hosts. Their jaws are usually armed with a simple pair of incurvated scrapers with which they scrape the surface of their hosts' bodies. Their stomachs never contain the blood of their hosts, but are always filled with exfoliated epithelium and kindred superficial debris. Supported by these observations alone, the fact at once becomes evident that these creatures are not true parasites; but there is yet more testimony to be adduced in favor of these hitherto maligned coadjutors and promotors of animal hygiene. If one carefully separates the feathers on the body of a fowl and uses a good lens (10 diam.) he may observe *Liothe pallidum*, a true mutualist, busily engaged in removing exfoliated epithelium (scarf-skin) from the body of its host. It thoroughly cleans its allotted area, scraping away and swallowing

all of the waste products of the skin. Again, if the feathers themselves be examined, another mutualist (*Liothe saculatum*) may be seen freshening and beautifying their sheen by taking into its stomach all dead epithelial cells, etc., with which it comes in contact. Mutualists are found everywhere in nature, and wherever found are of essential service and benefit to the animals possessing them. From the giant cetacean to the microscopic rhizopod, from the savage lion to the timid field-mouse, from the kingly eagle to the tiny humming bird, no animal is without them. Butler's epigram:

"Big fleas have little fleas upon their backs to bite 'em;
And these fleas have other fleas and so *ad infinitum*."

is mainly true, only I insist that no true mutualist ever bites its host. Many mutualists never reside wholly with their hosts, but visit them occasionally to render them needful service. The famous crocodile bird visits its host in order to pick its teeth; Buphagus, the surgeon of the buffalo, alights on the back of its host, and, with its sharp, lance-like beak opens the cells of encysted larvæ and removes them; the European starling performs a like service in removing "wolves" from the backs of cattle.

In matters of the toilette many animals are entirely dependent on the ministrations of mutualists. This is notably the case with many of the fish family. I placed two gilt catfish, whose skins had been thoroughly cleaned with a solution of salt water and borax, in a tank of filtered water in which there were no *Gyropeltes*, the mutualists of this species of fish. In two days their skins had lost their beautiful golden sheen and had become dull and lusterless. The fish themselves clearly showed by their actions that they were not in good health. They remained at the bottom of the tank almost without motion. I then took them out and found that their skins were covered with a slimy mucous exudate. I placed them for a few moments in a tank of pond-water in which there were multitudes of *Gyropeltes*. After allowing them to remain in this tank for a few moments, they were removed and examined, and thousands of these mutualists were discovered greedily devouring the mucous. After a day's residence in the pond water their skins had recovered all their lustre and beauty, and the fish showed by their actions that they had regained their health. A truly remarkable mutualist is found associated with the crayfish. It belongs to the genus *Histriobdella*, and its office is analagous to that of the vulture, the jackal, and the burying beetle which remove carrion. It is exceedingly agile and is altogether one of the most unique in appearance of all animals. It may be described as a two-legged

worm, which has all the powers of a most accomplished contortionist. The crayfish, after oviposition, carries its eggs beneath its tail, and the *Histriobdella* lives among them. Its office or function is to devour all blighted or unimpregnated eggs and dead embryos, the decay of which might affect the health of its host and progeny. Van Beneden, describing the *Histriobdella* found associated with the lobster, says: "Let us imagine a clown from the circus, his limbs dislocated as far as possible, we might even say entirely deprived of bone, displaying tricks of strength and activity on a heap of monster cannon balls, which he struggles to surmount; placing one foot formed like an air-bladder on one ball, the other foot on another, alternately balancing and extending his body, folding his limbs on each other, or bending his body upward like a caterpillar of the family *geometridæ*, and we shall then have but an imperfect idea of all the attitudes which it assumes, and which it varies incessantly." I once saw one of these little animals stand erect on its legs, then bend its body down between them and, with a quick flirt, turn a complete summersault. I have repeatedly seen this mutualist insert its proboscis into the eggs of crayfish and devour them. Microscopic investigation always showed that the eggs thus attacked were unimpregnated, consequently unfertile. I might prolong this paper by introducing many other mutualists, but think it hardly necessary. I have shown that these creatures subserve a very useful purpose in nature, and that they do not belong to that disreputable class—the parasites.—Jas. Weir, Jun., M. D.

ARCHÆOLOGY AND ETHNOLOGY.

Ancient American Bread.—Mr. S. P. Preston, of Lumberville, told me on April 1st, 1894, that he remembered his grandfather, Silas Preston, telling him how the latter, when a boy living on the farm now owned by Benjamin Goss, in Buckingham township, Bucks County, Pa., had seen Delaware Indians, about the year 1780, encamped in barked-roofed wooden huts near by, pound corn in stone mortars with stone pestles. They mixed the meal with water, and patting the dough into flattened balls with their hands, baked these cakes in the hot embers of their open fires. He did not tell his grandson whether they salted the meal, or—what was more important, if we want to try the experiment—whether the corn grains were pounded when old and well dried, which would be a difficult operation; when green and soft, which would be easier, or after previous parching, which would be easiest of all.

Franklin (Harshberger on Maize, p. 140) speaks of Indians, probably Delawares, parching corn grains in dishes of hot sand and afterwards grinding them to a fine powder, which kept fresh a number of years. Captain John Smith saw Indians roasting corn on the ear green, and when thus parched crisp, bruising it in a "wooden mortar with a polt and lapping it in rowles in the leaves of their corn, and so boyling it for a dainty."

Parching loose grains well stirred in an open iron dish does as well as either of the above methods in my experience and gets over the first and main difficulty of producing the meal or dough with a stone mortar and pestle. This meal, as I have made it, from freshly parched grain, is the easily produced Mexican Pinol, carried invariably on long desert journeys in Chihauhua and Sonora—sometimes seasoned with herbs or parched cocoa shells and generally mixed with sweetened water as a strengthening beverage.

The taste of cakes made of parched meal, I find on experiment, differs as much from that of others made from fresh grain as it does from the flavor of bread made by Mexican Indians from Metate crushed grains previously softened in hot lime water; but, given the meal, the Lenape process of cooking the dough in the embers of an open fire is that to-day in use by the negroes of Southern Maryland and Virginia. In an ash cake baked in the embers before me at Egglestons', Giles county, Virginia, in February, 1894, they reproduced the mode of the

Lenape cook, while with their hoe cakes, originally baked by the corn-field hands on hoe blades thrust into the wattle and clay fire places in log cabins, another Indian cake, that cooked on flat heated stones is imitated.

The Lenape word "Pone" (pronounced by the Delawares *ach pone*, and meaning baked corn bread), much used in Virginia to mean all kinds of corn bread, including the Johnny cake (baked on a greased board like a planked shad), is not needed to show that maize bread cooking—the best of it on the Atlantic seaboard, is a direct inheritance from the Indian.

Virginians justly despise all corn bread made north of Mason and Dixon's line. We use red corn instead of white, say they, which spoils the flavor, grind the meal coarse, which spoils the grain, and lastly, bake the meal (sometimes at mills) to save the frequent grinding necessitated in the South (once a week in summer and once in three weeks in winter) to prevent fermenting which destroys the vitality.

These alleged reasons may not fully account for the abominable corn bread of the North, but it is possible that the Indians had developed valuable modes of preparing the grain of their great plant, which neither Virginian nor Northerner have understood.—H. C. MERCER.

The making of New Jersey Coast Shell heaps in 1780. —To learn from Mr. Preston that even these squatting, half-civilized Lenape, in Buckingham, as lately as 1780, went over to the sea to make shell heaps once a year, is to lessen our surprise at the man-made shell deposits of the New Jersey coast, for if these conspicuous remains of shell feasts were built up, not only by coast-dwelling tribes, but by an Indian population from a good range of interior country, we need not wonder that they are very large or suppose that they are very old.

The Indians were in the habit of going in a body several days' walk, said Mr. Preston, the elder, in April or May to the clam banks of the New Jersey coast, near New Brunswick. There they encamped for several weeks to feast on clams, and when they retnrned, brought to the old and infirm who had remained at home, bundles of clams slung in skins on pairs of poles running from shoulder to shoulder of two men.

Even their stone-pointed arrows were sometimes used, at that time by these tolerated stragglers, who had sold the land they lived on in 1737, as when during mowing season, they shot robins and "flickers" (golden-winged woodpeckers) in black cherry trees with bows and arrows and strung the birds on long cords. Land turtles

were cooked for food, as when Mr. Preston saw a woman throw an *apron* full into an open fire, while another poked the tortured creatures back into the coals with a pole till they were roasted. It was remembered as a good joke that during a boiling of lye and soap fat for soft soap, an Indian woman coming to the kettle in the absence of the cooks, was seen to grease her hair with the mixture.—H. C. Mercer.

The Hemenway Collections.—The trustees of the Peabody Museum of Ethnology, in Cambridge, received a letter from Mr. Augustus Hemenway offering them, on behalf of the trustees of the estate of Mrs. Mary Hemenway, the incomparable collection of archeological specimens gathered during the last seven years by Mr. Frank H. Cushing and Dr. J. Walter Fewkes in Arizona and New Mexico.

These collections are not offered as a gift, but merely as a deposit. The trustees of the museum have accepted the loan, and have offered a sufficient space for its display. It is probable, however, that the deposits will amount practically to a gift.

A condition of this deposit is that Dr. J. Walter Fewkes, who has been in charge of Mrs. Hemenway's archeological enterprises since Mr. Cushing was compelled, on account of continued ill-health, to retire, shall continue in charge of the collection, although, of course, under the direction of Prof. Putnam, the curator of the museum.

The collection, which may be divided for convenience's sake into two parts, that formed by Mr. Cushing and that by Dr. Fewkes, is now widely scattered.

The portion excavated in the vicinity of Phenix and Tempe, Ari., by Mr. Cushing, is at present stored in Salem, Mass., while some of the results of Dr. Fewkes' expedition to the Moqui Indians of New Mexico are stored at 42 Mt. Vernon Street, Boston, and the rest are on exhibition in the National Museum in Washington.

How soon these portions will be united in Cambridge has not yet been decided, but it is reasonable to suppose by next fall there will be a fairly complete display open to the public at the Peabody Museum.

The indirect cause of these collections was the explorations which Mr. Cushing carried on among the Zuñis of New Mexico. The Zuñis seemed to Mr. Cushing to possess remnants of certain customs and habits which might possibly be referred back to the prehistoric inhabitants of the ancient pueblos or towns, the big, low, communal buildings which lie in ruins throughout the southwestern part of the United States.

A thoroughly equipped expedition, the entire expenses of which were paid by Mrs. Hemenway, who had become interested in Mr. Cushing's project, started for Arizona in 1887. For three years a most thorough,

careful and scientifically conducted expedition was carried on among these pueblos under the direction of Mr. Cushing.

The collection of specimens, including almost every variety of prehistoric implement, utensil and ornament in use among the ancient dwellers, which Mr. Cushing obtained is the most valuable ever carried out of Arizona. There is nothing from the same region comparable to it anywhere. Even more valuable are the facts which Mr. Cushing was enabled to learn from his explorations about the life and religious habits of this heretofore mysterious race. As yet, however, the facts have not been published by Mr. Cushing, who, since his illness, has been employed by the national government.

The explorations of Dr. Fewkes were made during the summers of 1890, 1891, 1892 and 1893. They were confined exclusively to the Moqui and Zuñi tribes.

Much attention was paid to the religious ceremonies of the Zuñis. A set of phonograph cylinders, recording their religious songs, was obtained during the summer of 1890. The cylinders, of course, are preserved in the Hemenway collection.

A year or so later the magnificent Keam collection was acquired by purchase. Keam had been a trader among the Moqui Indians for twenty years. Like most Indian traders, he had acquired a collection of utensils and religious paraphernalia, collected with an idea to sell at some future day. He had refused to sell single pieces, keeping the whole lot intact for some future purchaser. Every specimen was labeled with a short description. In its numbers are included both ancient and modern articles—blankets, basket ware, religious and household pottery, kilts, dolls (which are made in the likeness of idols, serving as a sort of kindergarten instruction to the children in religion), in fact, almost every type of old and new, of everything in use among the Moquis and their predecessors. Not only is the collection the best in the world, but it must always remain so, for the Moquis have by this time become sophisticated by white civilization. Added to this Keam collection are the valuable supplementary collections gathered by the Hemenway expedition itself.

Thirty-five hundred specimens were beautifully arranged in the exhibition held two years ago in Madrid to commemorate the four hundredth anniversary of the discovery of America. These specimens were intended to illustrate the habits of the natives of New Mexico at the time of the landing of Columbus. They gained Mrs. Hemenway a personal letter of thanks from the Queen of Spain, and their curator the decoration of the Order of Isabella the Catholic.

MICROSCOPY.[1]

New Method of Imbedding in a Mixture of Celloidin and Paraffine.[2]—Messrs. Field and Martin recommend the following method as an improvement on those proposed a few years ago by Ryder and Kultschizky. The method permits of imbedding the object directly in a mixture of celloidin and paraffine. The mixture is prepared by using as a solvent, alcohol and toluol (toluène); the latter, taking the place of ether, makes it possible to dissolve paraffine in the celloidin solution. Proceed as follows:

1. Make a mixture of absolute alcohol and toluol in equal parts.

2. Soak some dry celloidin in toluol; after some hours, add a little of the alcohol-toluol.[3] The celloidin swells up and dissolves. The solution should have about the consistency of clove oil.

3. Finally, add to this mixture some shavings of paraffine, obtained by scraping the surface of a block of this substance with a scalpel. In order to hasten the solution and increase the proportion of paraffine the mixture may be heated a little. Above 20° to 23°, one runs the risk of precipitating the celloidin, which separates in a transparent granular mass.

These mixtures prepared, the process of imbedding is executed in the following manner: The object, taken from absolute alcohol, is placed in the alcohol-toluol. It is easily and quickly saturated, and is then placed directly in the imbedding mixture. The penetration is more rapid than in the ordinary celloidin solution. As soon as saturation is complete, one may proceed to solidify the celloidin. This may be done in two ways:

1. The object is transferred to a saturated solution of paraffine in chloroform, and when the solidification is complete (2–3ds.), the imbedding paraffine is carried out according to the well known method Bütschli.

[1]Ed. By Prof. C. O. Whitman, University of Chicago.

[2]Bull Soc. Zool de France, XIX, p. 48, Mar. 13, 1894, and Zeitschr. f. wiss. Mikr., XI, 1, 1894.

[3]The alcohol-toluol is added after the tuluol has been turned off. About 45cc is enough for 1 grm. of celloidin. This solution will dissolve about ½ grm. of paraffine (melting at 56°) at ordinary room temperature.

2. The object is placed in toluol containing some paraffine in solution. The alcohol diffuses in the excess of toluol, and the celloidin solidifies. Imbed as before.

In both cases care must be taken to avoid shrinkage, which occurs if the celloidin is solidified in pure paraffine.

The object thus imbedded in paraffine is sectioned in the usual way. The ribbons of sections are fixed to the slide by means of the ordinary albumen fixative, or by the aid of pure water. In the latter case, the strips cut to the length desired are placed on a clean slide slightly wet with water. Then a little water is added by means of a brush, just enough to barely float the sections[4] The slide is then heated so as to soften the paraffine without melting it. The sections expand readily. It remains only to drain off the water and let the slide dry completely.

If desired the celloidin may be removed by the mixture of alcohol and toluol which dissolves at once both the paraffine and celloidin. Then, after washing with toluol, the sections may be mounted in balsam in the usual way. If they are to be colored on the slide, they should be washed with alcohol and water.

On the Fixing of Paraffine Sections to the Slide.—A combination of the water method of Suchannek and Heidenhain with the albumen method of Mayer has been found very useful as it does away with the slow-drying of the former method and still permits the ready arrangement of the sections and their expansion and flattening.

A slide, cleaned with only ordinary care, is covered by means of the finger with the least possible amount of Mayer's Albumen. By means of a small brush the upper surface of the slide is then flooded with water and the brush, still slightly wet, is used for picking up and arranging the sections or ribbons. The brush may then be used for removing the excess of water, and the slide slightly warmed for a few moments on a water-bottle, care being taken that the sections do not melt. The sections soon expand and float upon the water which should be drained away and slide placed a second time upon the water-bath. After remaining about fifteen minutes the paraffine may be melted and the slide plunged into turpentine or some other solvent of paraffine.—H. C. BUMPUS, Marine Biological Laboratory, Woods Holl, Mass.

[4]The following note by Dr. Bumpus suggests an improvement.

SCIENTIFIC NEWS.

The work of the Michigan Fish Commission in 1894.—After a careful study of various points along the coast, Charlevoix has finally been decided upon as the location for the work of this year. It lies on the eastern shore of Lake Michigan just north of Grand Traverse Bay, within easy reach of numerous white fish spawning and fishing grounds. Extensive fishing operations are carried on here throughout the year, and varied conditions of shore and bottom are to be found within easy reach. Opposite this point Lake Michigan reaches a depth of 850 feet, and shallow water with reefs and islands are not far distant. Numerous inland lakes of varying size are also readily accessible and the variety of conditions is unsurpassed by any point on this shore. In addition to this the Commission has already at Charlevoix a hatchery which will furnish extensive aquaria for keeping specimens alive and for experimental work. A carpenter shop next door to the hatchery building has been rented for the summer and fitted out as a laboratory, with tables, shelves, reagents and the necessary apparatus. The University of Michigan co-operates with the undertaking as in former years, and has renewed its loan of apparatus and of a special library. Several boats, including a small steamer and all kinds of nets for shallow and deep water work and for bottom and surface collecting, are at the service of the party.

The work will include a determination of the fauna and flora of Lake Michigan at this point and of their vertical and horizontal distribution. This determination will be both qualitative and quantitative, and will be particularly directed towards a study of the life history of the white fish and lake trout. Since the life of the water constitutes, first or last, the food of the fish in it, this determination will afford some idea of the value of this locality as a breeding ground for fish and of its adaptability as a planting ground for the fry. The temperature, transparency and purity of the water and the character of shore and bottom, as well as the currents and connecting lakes will receive attention as problems which affect most powerfully the welfare of the fish.

The party at work in the laboratory will consist of Professor Henry B. Ward, University of Nebraska, Director; Professor E. A. Birge, University of Wisconsin; Professor C. Dwight Marsh, Ripon College, Wisconsin; Dr. Charles A. Kofoid, University of Michigan; Dr. Robert H. Walcott, University of Michigan; Mr. Herbert S. Jennings, University of Michigan; Mr. Bryant Walker, Detroit, Michi-

gan. In addition to these, a number of specialists will be guests of the Commission for a longer or shorter interval.

The laboratory will be open during July and August, and visiting scientists will be accorded a most cordial welcome. To a certain extent it will be possible to offer the privileges of the laboratory to specialists who may wish to carry on investigations on special groups. Notice of such cases should be sent to the director as early as possible, that the necessary arragements may be made.

The Biological Station of the University of Illinois.—The field operations and the resources of the natural history departments of the University, especially those of zoology and botany, have been notably increased during the last term by the establishment, April 1, on the Illinois River, at Havana, of a biological station devoted to the systematic and continuous investigation of the plant and animal life of the waters of that region. This establishment, authorized by the trustees of the University at their March meeting, is under the direction of Professor Forbes, with Mr. Frank Smith, assistant in zoology, in immediate charge of the work. Mr. Adolph Hempel and Mrs. Smith also work there continuously, with an expert fisherman as factotum.

The field work is now done from a cabin boat, chartered for the summer, which carries the seines, dredges, surface nets, plankton apparatus, and other collecting equipment, together with microscopes, reagents for the preservation of specimens, a small working library, a number of special breeding cages for aquatic insects, and a few aquaria. This boat is provided with sleeping accommodations for four men, and with a well-furnished kitchen.

In Havana itself are office and laboratory rooms supplied with running water and electric light, and provided with the usual equipment of a biological laboratory, consisting of first-class microscopes, microtomes, biological reagents, etc., and tables for five assistants. Professor Forbes and Mr. Hart, of the state laboratory of natural history, visit the station frequently for special lines of work.

The boat is established in Quiver Lake, an elongate bay or Illinois, two and a half miles above Havana. At low water this lake is about two miles long with a steep sandy bank some fifty feet high on the eastern side and a mud flat on the western. The banks are wooded, on the east mostly with oak and hickory, and on the west with the lowland species. The locality is beautiful and healthful, and the water excellent.

From the lake and the river selection has been made of a number of

typical situations, and from these, and from Phelps and Thompson Lakes a little distance away, collections of all descriptions are made at regular intervals for a comparative study of the organic life—the relative abundance of the species at different seasons of the year, and the general system of conditions by which it is affected.

The plan of operation contemplates continuous work at this station for several years, with especial reference to the effect of the enormous overflow and rapid retreat of waters characteristic of the Illinois and the Mississippi system generally. Continuous studies are made of the food of all the species collected, with final reference to the feeding habits and food resources of the native fishes of the region. Temperatures are taken daily, and analyses of the waters of the lake and river at the various stations are being made at regular intervals by the chemical department of the University.

This station will be held open for graduate students in zoology and botany wishing to take their advanced degrees in zoological or botanical lines. Such students, choosing to pursue their studies at Havana will be furnished with every facility for the original investigation of a large variety of subjects, and arrangements will be made by which the other studies of their postgraduate courses may be carried forward without embarrassment.

The station is further capable of sufficient expansion to accommodate other investigators from the University and from the University summer school, for whose benefit excursions will be arranged as may be found profitable.

This is the first inland aquatic biological station in America manned and equipped for continuous investigation; and the first in the world to undertake the serious study of the biology of a river system.—*From the Illini, June* 6, 1894.

Cook's Excursion to Greenland.—The excursion to visit Greenland organized by Dr. Frederick A. Cook, anthropologist of Peary's first expedition, consists of fifty persons, of whom a good part are students of science. They have chartered the steamer Miranda and will sail directly for the far north, stopping at Cape Breton, and at two or three places in Labrador and Southern Greenland, reaching Inglefield Gulf about the first of August. Among the scientific members are Professor W. H. Brewer of Yale College, who will go the whole round; Professor B. C. Jillson of Pittsburg, Pa., who with Professor G. F. Wright and son, of Oberlin, O., and a party of six, will stop off in Umenak Fiord about latitude 71, to study the border of the ice sheet, the neighboring glacial deposits, the glaciers entering the

fiord, the Tertiary deposits of the vicinity, and make a collection of the plants and animals.

Professor L. L. Dyche, at the head of the department of Zoology and Taxidermy at the State University of Kansas, is the official naturalist of the expedition, and will go the full round. He will make a specialty of collecting Birds and Mammals. He will have under him Mr. S. P. Orth of Oberlin, O., botanist, and B. F. Stanton of Oberlin, assistant naturalist, to make general collections. Mr. E. A. McIlhenney of Louisana, goes as an ornithologist.

Professer C. E. Hite of Philadelphia with three assistants is to stop off in Labrador for general exploration. Professor E. P. Lyon of Chicago goes for the general student of biology. The expedition expects to return about September 20th.—G. F. WRIGHT.

The Forty-third Meeting of the American Association for the Advancement of Science, will he held in Brooklyn, New York, August 15 to 24, 1894. The following officers will be in charge:

President, Daniel G. Brinton, Media, Pa.

Vice-Presidents, A.—Mathametics and Astronomy, George C. Comstock, Madison, Wis.; B.—Physics, Wm. A. Rogers, Waterville, Me.; C.—Chemistry, T. H. Norton, Cincinnati, O.; D.—Mechanical Science and Engineering, Mansfield Merriman, South Bethlehem, Pa.; E.—Geology and Geography, Samuel Calvin, Iowa City, Iowa; F.—Zoology, S. H. Scudder, Cambridge, Mass. (Resigned); G.—Botany, L. M. Underwood, Greencastle, Ind.; H.—Anthropology, Franz Boaz, New York; I.—Economic Science and Statistics, Henry Farquhar, Washington, D. C.

Permanent Secretary, F. W. Putnam, Cambridge (office, Salem), Mass.

General Secretary, H. L. Fairchild, Rochester, N. Y.

Secretary of the Council, James Lewis Howe, Louisville, Ky.

Dr. August von Klipstein, formerly Professor of Mineralogy at Giesson, died, April 16, 1894, in his 93d year.

The news of the appointment of Sidney J. Heckson of Downing College, Cambridge, to the Chair of Zoology at Owens College, Manchester, will prove welcome to his many friends.

Science in Persia! The Shah has instituted a zoological garden.

Dr. Joseph Hyrtl, the anatomist, died, July 17, 1894. He was born on Dec. 7, 1811, at Eisenstadt, Hungary, and studied at Vienna, where he obtained, at the age of twenty-one, the position of preparator. He was chosen in 1837 as professor in the University of Prague, and

in 1845 returned to Vienna as professor of anatomy at the university there. In 1857 he became a member of the Imperial Academy of Sciences. He was one of Austria's most distinguished anatomists and the author of two works which have come to be accepted as standard authorities throughont the world—"The Manual of Physiological and Practical Anatomy" and "The Manual of Topographical Anatomy and Its Applications." Dr. Hyrtl, being very skilful in the art of preparing anatomical specimens, established in Vienna an anatomical museum, of which he published a most interesting description. He had enriched most of the anatomical collections of Europe with models of rare perfection. One of his collections, that of the skeletons of fishes, was purchased by Prof. Cope of Philadelphia. He was for a time director of the Ecole Superieure, resigning the position in 1874.

Dr. George Huntington Williams, professor of geology at Johns Hopkins University, whose death occurred in July, founded the department of mineralogy and geology at the Johns Hopkins in 1883, and since that time had acquired a wide reputation among scientific men for his intimate knowledge of the geology and topography of Maryland. He was also a collaborator of the United States Geological Survey, and prepared a number of special reports for the survey during his summer vacation. He was born Jan. 28, 1856, at Utica, N. Y. His connection with the Johns Hopkins dates from March, 1883, when he entered the university as a fellow by courtesy. In October of that year he was added to the faculty as an associate in mineralogy. In 1885 he was made an associate professor, and in 1892 was chosen to the chair of inorganic geology. His writings include nearly a hundred geological and mineralogical papers in scientific journals, more than one-half of which treat of the geology of Maryland, especially in the vicinity of Baltimore. He wrote "The Elements of Crystallography," and had been engaged for a number of years in preparing a new geological map of Maryland for the United States Geological Survey. He was one of the judges of the mines and mining exhibit at the World's Fair, an editor of the Standard Dictionary, recently issued, and of Johnson's Cyclopedia, now in press. He was a member of the National Academy of Sciences, a vice-president of the Geological Society of America, and a member of the American Institute of Mining Engineers, the Washington Geological Society and other scientific bodies.

Johannes Nill, founder of the Stuttgart Zoological Garden. died in that city May 20, 1894; his son, Adolf Nill, is his successor in the management of the garden.